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ABSTRACT

The comprehensive study, based on 1970 census data and other recent information from a variety of sources, provides assessment of trends and a projection of future States as well as the State of Ohio. Besides meeting the primary end objective of providing a basis for projecting enrollment needs in agriculture and natural resources in the College of Agriculture and Home Economics at Ohio State University, the study statistically reveals to decision-makers and to the public "that the number of professional personnel in agriculture and natural resources has been increasing rapidly and can be expected to continue to increase in the foreseeable future." Data are presented in 73 tables which are categorized in seven main sections: (1) Total College-Educated Manpower, and College Enrollments and Degrees (United States); (2) Scientists and Engineers and Degrees (United States); (3) Science and Engineering Doctorates (United States); (4) Trends in Agriculture and Natural Resources (United States); (5) Professional Manpower in Agriculture and Natural Resources (United States); (6) Enrollment and Degrees, Agriculture and Natural Resources (United States); and (7) Selected Professional Manpower Trends and Enrollment and Degrees, Agriculture and Natural Resources (Ohio). (EA)

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PROFESSIONAL MANPOWER AND BACHELOR'S AND GRADUATE ENROLLMENT AND DEGREES IN AGRICULTURE AND NATURAL RESOURCES

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PROJECTIONS TO 1980 FOR THE UNITED STATES AND OHIO

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January, 1974

Introduction

The future strength of the United States and of Ohio depends in large measure on how well and how efficiently its citizens are fed, and how well and how carefully its natural resources are managed and utilized.

In addition, the quality of life in the future will depend on how well we can supply basic human needs without aesthetic deterioration of our environment, and excessive depletion of our resources.

This report assesses trends and projects needs for professional manpower in agriculture and natural resources. For the most part, we present data on a national basis. This is because 1) the "market" for agricultural and natural resources graduates of the Ohio State University is a national one, and 2) national manpower data are much more readily available than are Ohio figures. Somewhat arbitrarily, we have defined "professional" positions as being those which are presently occupied by graduates of bachelor's or advanced degree programs, or which might normally be expected to be occupied by such graduates as replacements are needed during the next generation.

The exclusion of the rapidly growing vocational and technical programs (high school and post-high school) in agriculture and natural resources by no means denigrates their importance. Two important considerations are relevant in the limitation

of this study to the professional sphere: 1) the primary end objective of this study is to provide a basis for projecting enrollment needs in agriculture and natural resources in the College of Agriculture and Home Economics at The Ohio State University, and 2) a study such as this, which attempts to pull together the total manpower need for all professions within agriculture and natural resources, is immensely time-consuming, and time was not available to permit addition of the vocational and technical dimensions (although the need for teachers and other professionals in these programs is included). Many studies have been made, primarily by departments of agricultural education in colleges of agriculture, and by State Departments of Education, of the needs for graduates in these areas.

Although the need for a comprehensive study of the demand for college graduates in agriculture and natural resources has been discussed many times over the years, this is the first time -- in the knowledge of the authors -- that such a study has actually been brought forth. We have been fortunate to have access to 1970 census data, which provides information that has not been available previously. We've also been able to pull together, from a variety of sources, other information which has been generated in recent years.

Necessarily, we have had to make some carefully considered estimates. But we believe that it is now possible to communicate to decision-makers and to the public, with documented confidence, what those in agriculture and natural resources have

known for many years: that the number of professional personnel in agriculture and natural resources has been increasing rapidly, and can be expected to continue to increase in the foreseeable future.

The information contained in this report consists primarily of data, illustrated visually for easy reference.

The gist of the report can be captured in a few minutes by reading the telegraphic headlines which appear above each figure. However, for the convenience of the reader, a summary follows this introduction.

We wish to acknowledge the assistance of many individuals and organizations, whose names appear in the footnotes to the tables in this report.

Summary

Topic	Figure & Table No.	Page	Number (000) 1960	1970	1980 Low	1980 Med.	1980 High
United States							
Manpower with College Degrees	5	20,21	7,350	10,610	14,990	-	15,620
Percent increase			-	44.4	41.3	-	47.2
Bachelor's Degrees Granted	10	30,31	369	840	1,115	1,305	1,605
Percent increase			-	122.0	32.8	55.6	91.0
Scientists and Engineers	18	50,51	1,172	1,735	2,372	2,580	2,870
Percent increase			-	48.0	36.7	48.7	64.4
Ph. D. Scientists and Engineers	24	68,69	NA	158.0[2]	253.3	-	280.9
Percent increase			-	-	60.3	-	77.8
Ph. D. Degrees Granted in Science and Engineering	26	72,73	7.1	20.4	20.7	23.1	25.6
Percent increase			-	186.6	1.5	13.2	25.5
Professional Manpower in Agriculture and Natural Resources	41	110-113	399.2	595.6	815.8	882.0	985.0
Percent increase			-	49.2	37.0	48.1	65.4
Bachelor's Degrees Granted in Agriculture and Natural Resources	66	170,171	7.4	15.8	23.4	26.6	28.4
Percent increase			-	113.5	48.1	68.4	79.7
Master's Degrees in Agriculture and Natural Resources	68	176-179	2,094	3,326	4,790	4,925	5,280
Percent increase			-	58.8	44.0	48.1	58.8

Topic	Figure & Table No.	Page	Number (000) 1960	1970	1980 Low	1980 Med.	1980 High
United States (cont.)							
Doctor's Degrees in Agriculture and Natural Resources	68	176-179	712	1,341	1,830	2.150	2,385
Percent increase			-	88.3	36.4	60.3	77.8
The Ohio State University--Agriculture and Natural Resources							
Bachelor's Program Enrollment[3]	72	190,191	1,416	2,142	3,470	3,875	4,135
Percent increase			-	51.3	62.0	81.0	93.0
Bachelor's Degrees Granted	72	190,191	231	487	790	880	940
Percent increase			-	110.8	62.0	81.0	93.0
Master's Degrees Granted	73	192,193	------80[4]------		115	120	130
Percent increase			-	-	44.0	48.9	58.8
Doctor's Degrees Granted	73	192,193	------80[4]------		70	80	90
Percent increase			-	-	36.4	60.3	77.8

1. Considered by the authors to be the projection most likely to be reached.
2. 1969.
3. Includes agriculture and natural resources-decided students in University College for 1970.
4. 1960-71 average.

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SECTION I

Total College-Educated Manpower and College Enrollments and Degrees

United States

Much attention has been focused during the past several years on unemployment among college graduates. However, the unemployment rates among professional manpower and college graduates have remained far below those for the entire labor force.

Figure 1a -- Unemployment Rates, 1969-73, U. S.

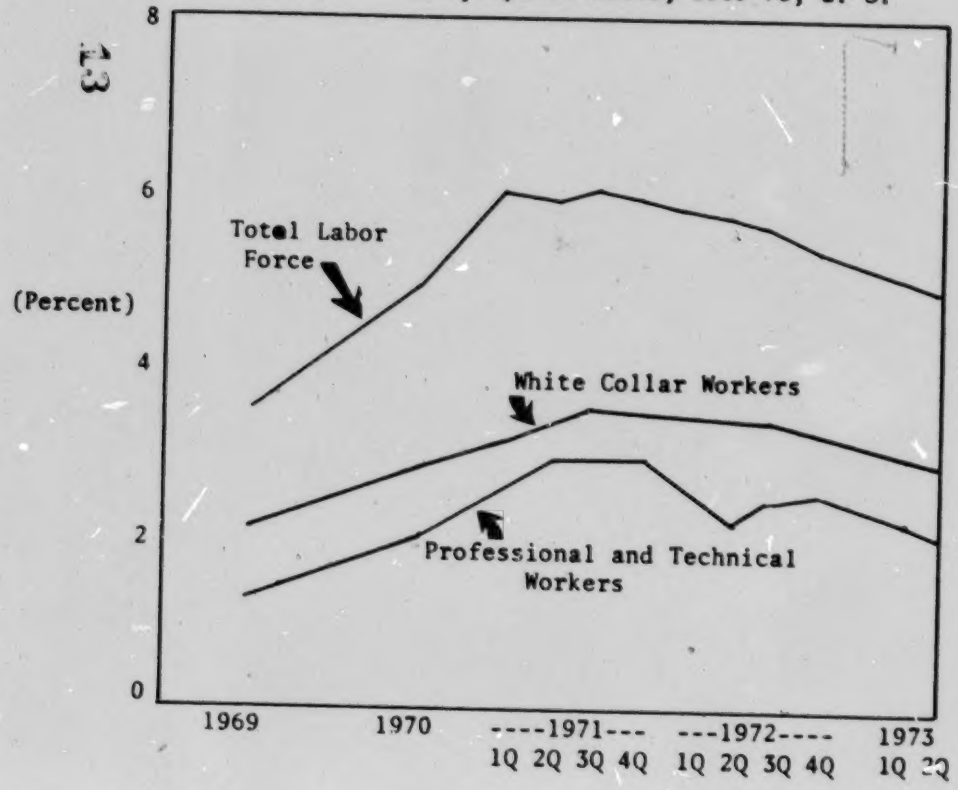

Figure 1b -- Unemployment by Educational Level, 1971

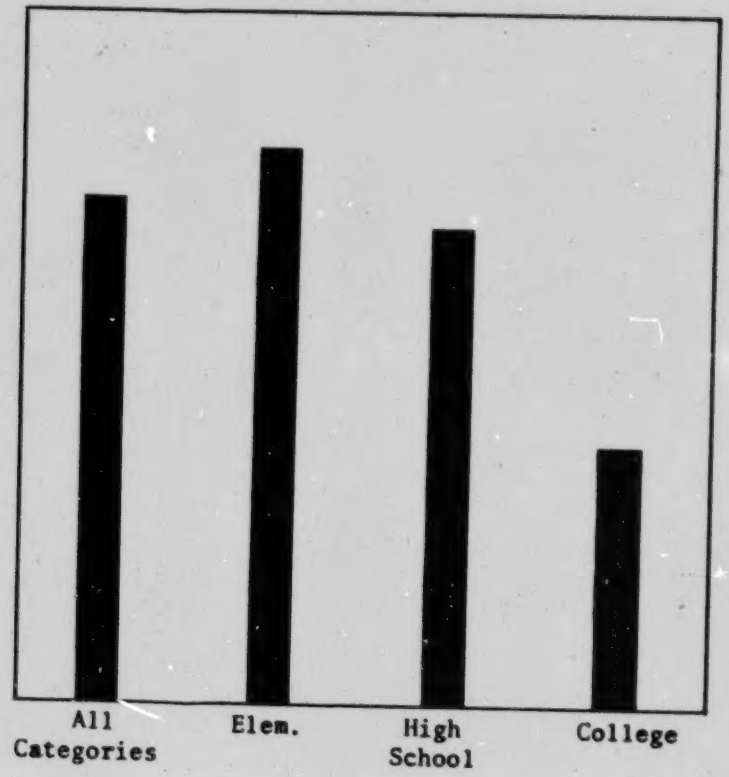

Table 1 -- Unemployment Rates in the United States

Regular Series[1]	1969	1970	1971 1st Q	1971 2d Q	1971 3d Q	1971 4th Q	1972 1st Q	1972 2d Q	1972 3d Q	1972 4th Q	1973 1st Q	1973 2d Q
All Categories	3.5	4.9	6.0	5.9	6.0	5.9	5.8	5.7	5.6	5.3	5.0	4.9
White-Collar Workers	2.1	2.8	----------3.5[2]----------				----------3.4[2]----------				---2.9[3]----	
Professional and Technical Workers	1.3	2.0	3.1	2.9	2.9	2.9	2.6	2.2	2.4	2.5	2.2	2.0

Special Study[4]	1st Q 1971
All Categories	5.8
Highest Educational Attainment:	
Elementary School	6.4
High School	5.5
College (4 years or more)	3.0

1. Source: U.S. Department of Labor, Bureau of Labor Statistics.
2. Average for the year.
3. February-July average.
4. Source: U.S. Department of Labor, Bureau of Labor Statistics, "Educational Attainment of Workers, March, 1971." Special Labor Force Report 140, 1972.

Although the recruitment of college graduates dropped during the economic recession, strong recovery has taken place.

Figure 2 -- Change in Employers' Hiring from previous year, all degrees, U. S.

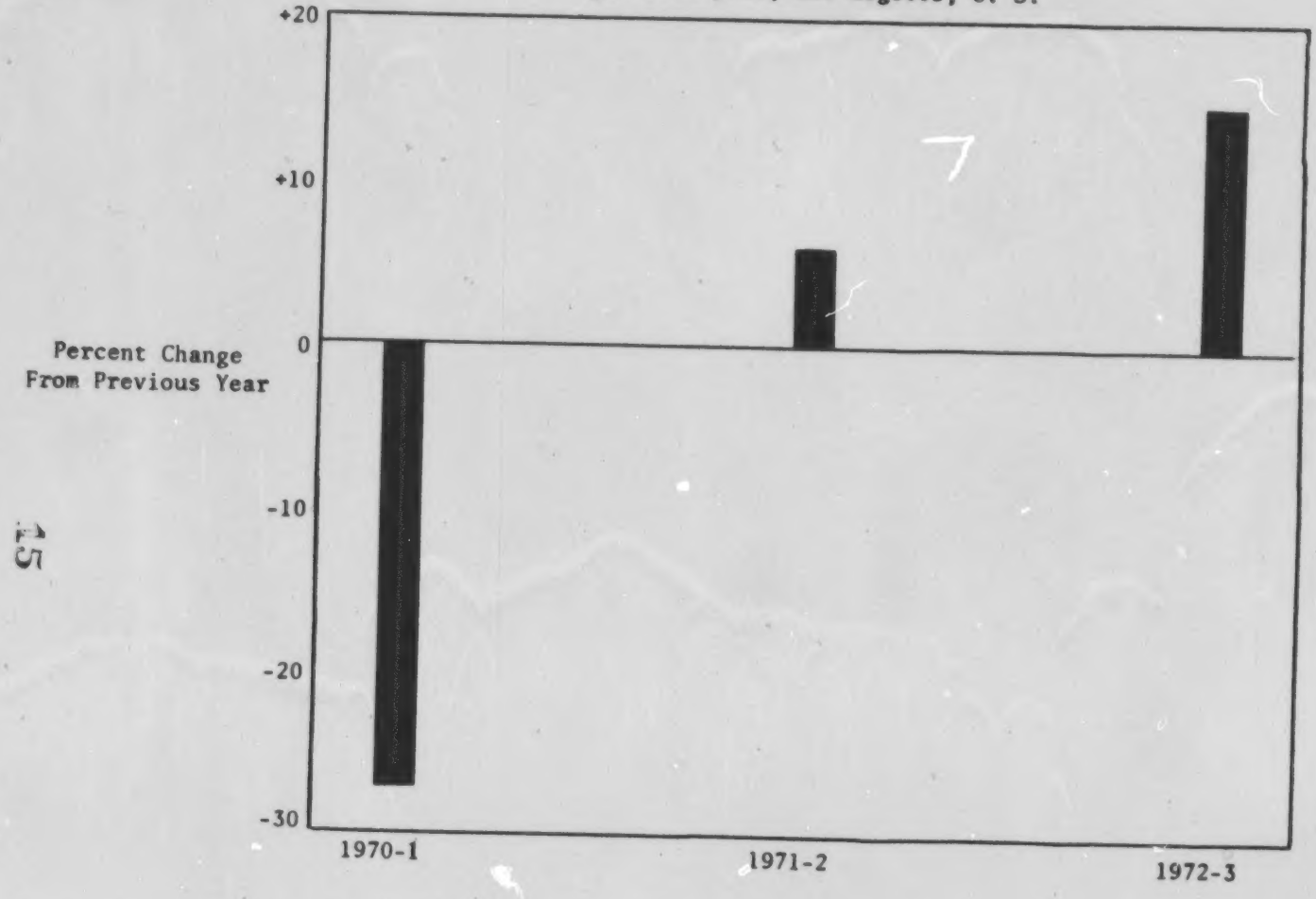

Table 2 -- Employers' Hiring of College Graduates, U.S.

(Percent change from previous year)

	1970-1	1971-2	1972-3
Bachelor's	-27%	+ 4%	+16%
Master's	-28%	+13%	+20%
Ph.D.'s	-31%	+25%	+28%
Unclassified	NA	+ 4%	+ 9%
All Degrees	-27%	+ 6%	+15%

Source: Annual survey by the College Placement Council, Inc., 65 E. Elizabeth Avenue, Bethlehem, PA, 18001, of hiring intentions of employers. Conducted each spring for the current academic year.

Demand during the past several years has been strongest for graduates in science, engineering and business.

Figure 3 -- Changes in Employers' Hiring From Previous Year, by Field, U. S

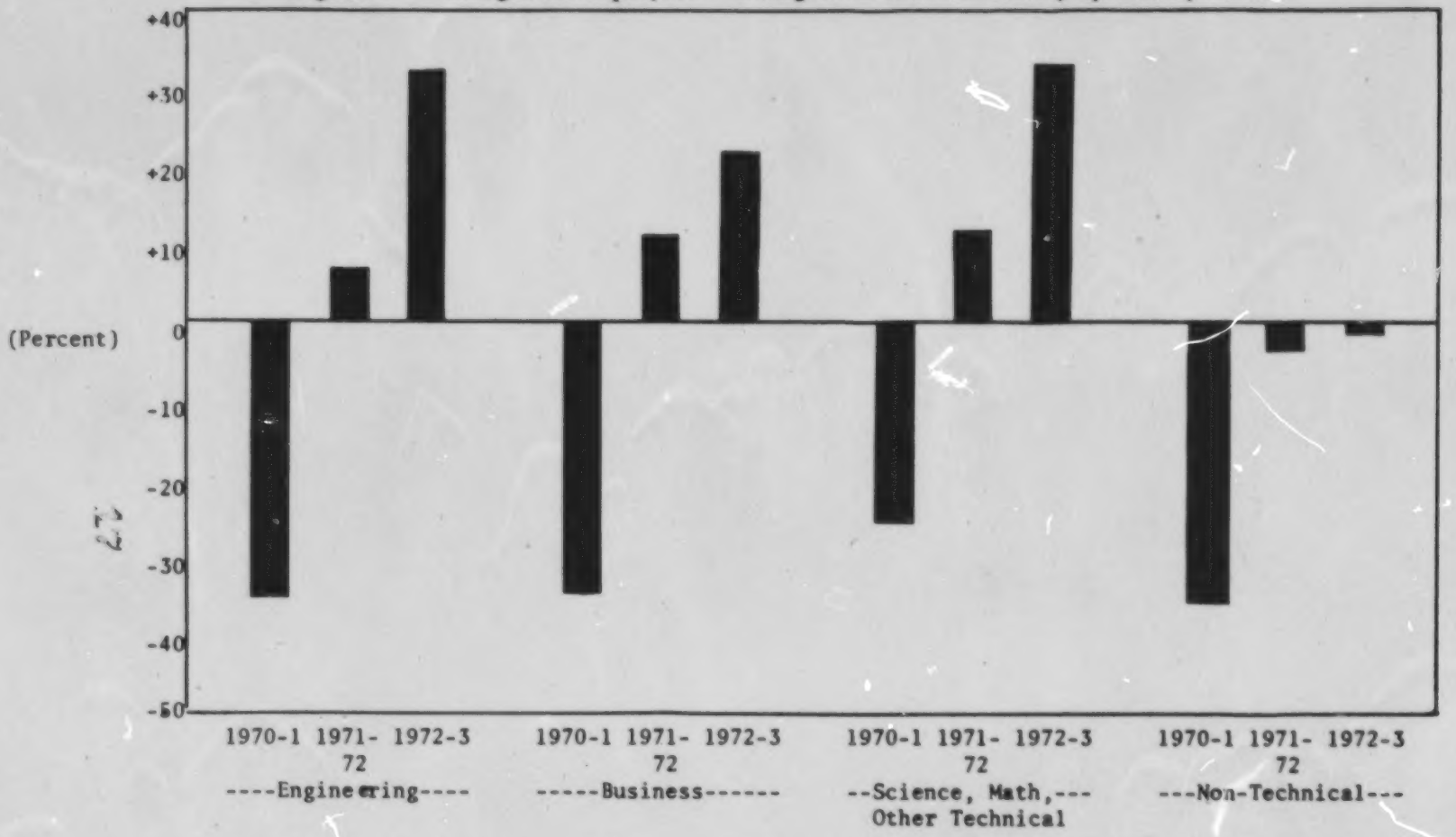

Table 3 -- Employers' Hiring of College Graduates, by Field of Study, U.S.

(Percent change from previous year)

	1970-1	1971-2	1972-3
Engineering	-35%	+ 7%	+32%
Business	-34%	+11%	+22%
Science, Mathematics, other Technical Fields	-25%	+12%	+33%
Non-Technical Fields	-45%	- 3%	- 1%
Unclassified	-13%	- 1%	- 5%
Total	-27%	+ 6%	+15%

Source: College Placement Council, Bethlehem, PA.

Employment in all major white-collar categories will increase during the 1970's, with professional and technical workers showing the greatest increase.

Figure 4 -- Employment by Category, U. S.

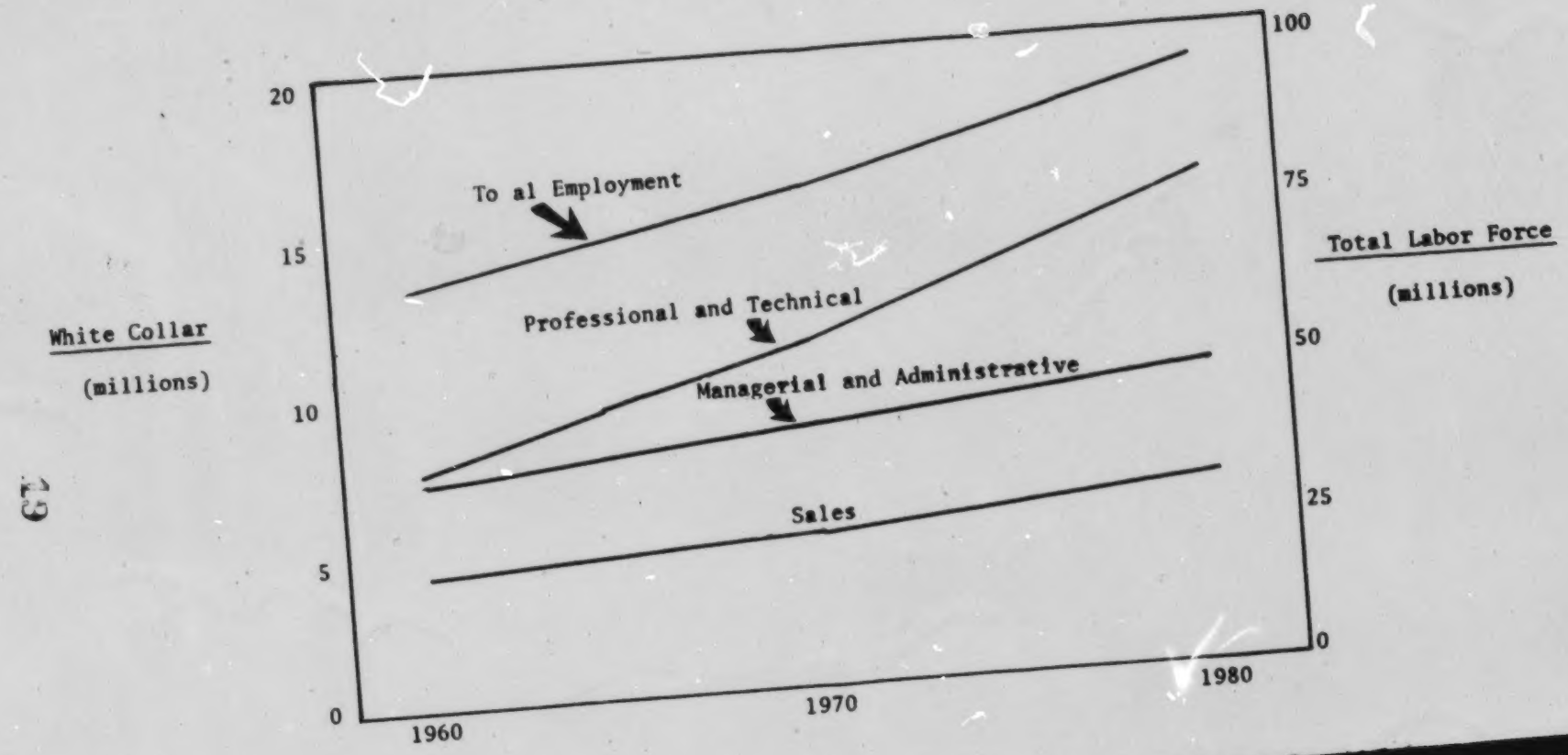

Table 4 -- Total Labor Force and White Collar Manpower, U.S.

(Millions)

	1960	1970	1980
Total Employment	65.8	78.6	95.1
Increase	--	19.5	21.0
Professional and Technical	7.5	11.1	15.5
Increase	--	48.0	39.6
Managerial and Administrative	7.1	8.3	9.5
Increase	--	16.9	15.9
Sales	4.2	4.9	6.0
Increase	--	16.7	22.4
Clerical	9.7	13.7	17.3
Increase	--	41.2	26.3
Total White Collar	28.5	38.0	48.3
Increase	--	33.3	27.2

Source: U.S. Department of Labor, "Manpower Report of the President, 1972," Appendix Table E-10.

The number of college graduates in the U. S. labor force will increase by nearly 50 percent during the 1970's.

Figure 5 -- College Graduate Manpower Levels, U. S.

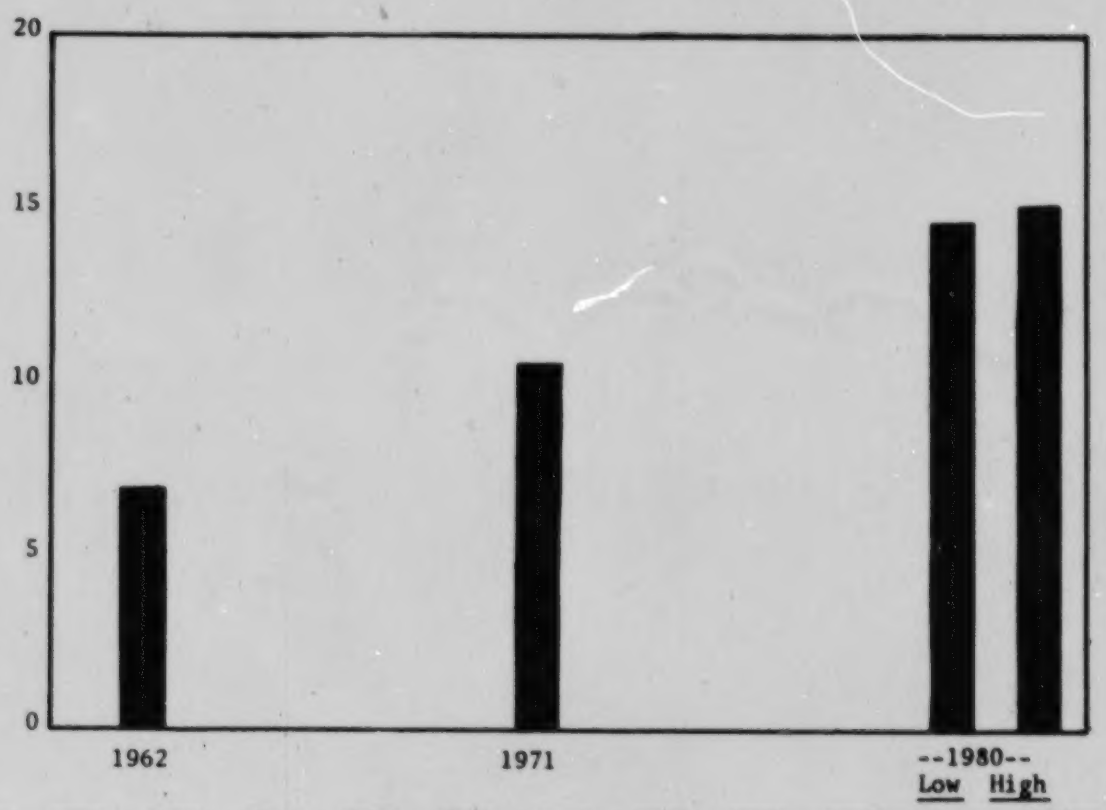

Table 5 -- College Graduate Manpower Levels, U.S.

(Millions)

	1962	1971	1980 Low	1980 High
Number with 4 or more years of college	7.35[1]	10.61[1]	14.99[2]	15.62[3]
Percent increase	--	44.4%	41.3%	47.2%

1. Source: U.S. Department of Labor, "Educational Attainment of Workers, March, 1971," Special Labor Force Report 140, 1972.

2. Basis: Extrapolation of 1962-71 trends in percentage of those in white-collar and all other categories completing 4 years or more of college. (Source: See footnote 1.)

3. Basis: U.S.D.L. projection of percentage of those in white collar categories completing 4 years or more of college, plus extrapolation of percentage of those in all other categories completing 4 years or more of college. (Source: U.S. Department of Labor, "Manpower Report of the President, 1972," page 114.)

Enrollment in college and university undergraduate programs has leveled off in the past several years, but growth in post-high school, less-than-bachelor's degree programs has been a factor in the continued upward growth in higher education enrollment.

Figure 6 -- College Enrollment, U. S.

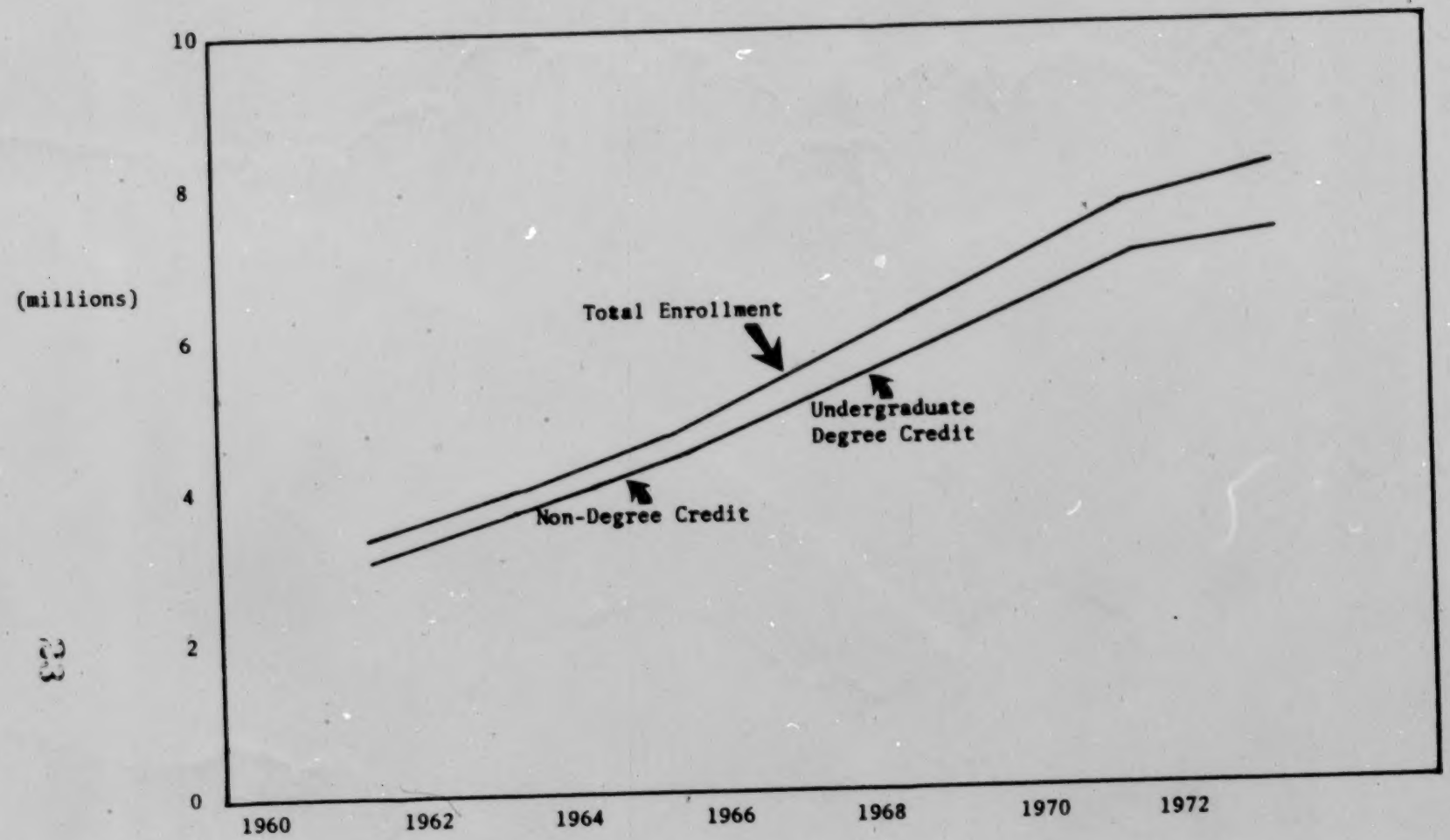

Table 6 -- Enrollment in Degree and Non-Degree Programs, U.S.

(Millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Undergraduate Degree Credit	3.2	3.5	3.8	4.0	4.4	4.9	5.25	5.65	6.1	6.65	7.0	7.2	7.3
Non-Degree Credit	.206	.186	.229	.271	.330	.395	.462	.505	.585	.610	.661	.833	.904
Total	3.4	3.7	4.0	4.3	4.7	5.3	5.7	6.2	6.7	7.3	7.7	8.0	8.2
Population Age 18-21	9.7	10.4	10.9	11.2	11.5	12.3	13.1	13.8	14.3	14.2	14.6	15.0	15.4
Percent Enrolled	35.1	35.4	37.0	38.1	41.2	43.2	43.5	44.6	46.8	50.4	52.5	53.6	53.3

Source: U.S. Office of Education, National Center for Educational Statistics, "Projections of Educational Statistics to 1981-82," 1972 Edition, DHEW Publication No. (OE) 73-11105.

The U. S. Office of Education has projected a nearly 40 percent increase from 1970 to 1980 in undergraduate degree credit enrollment. However, recent trends indicate that enrollment may increase by as little as 15 percent.

Figure 7 -- Undergraduate Degree Credit Enrollment, U. S.

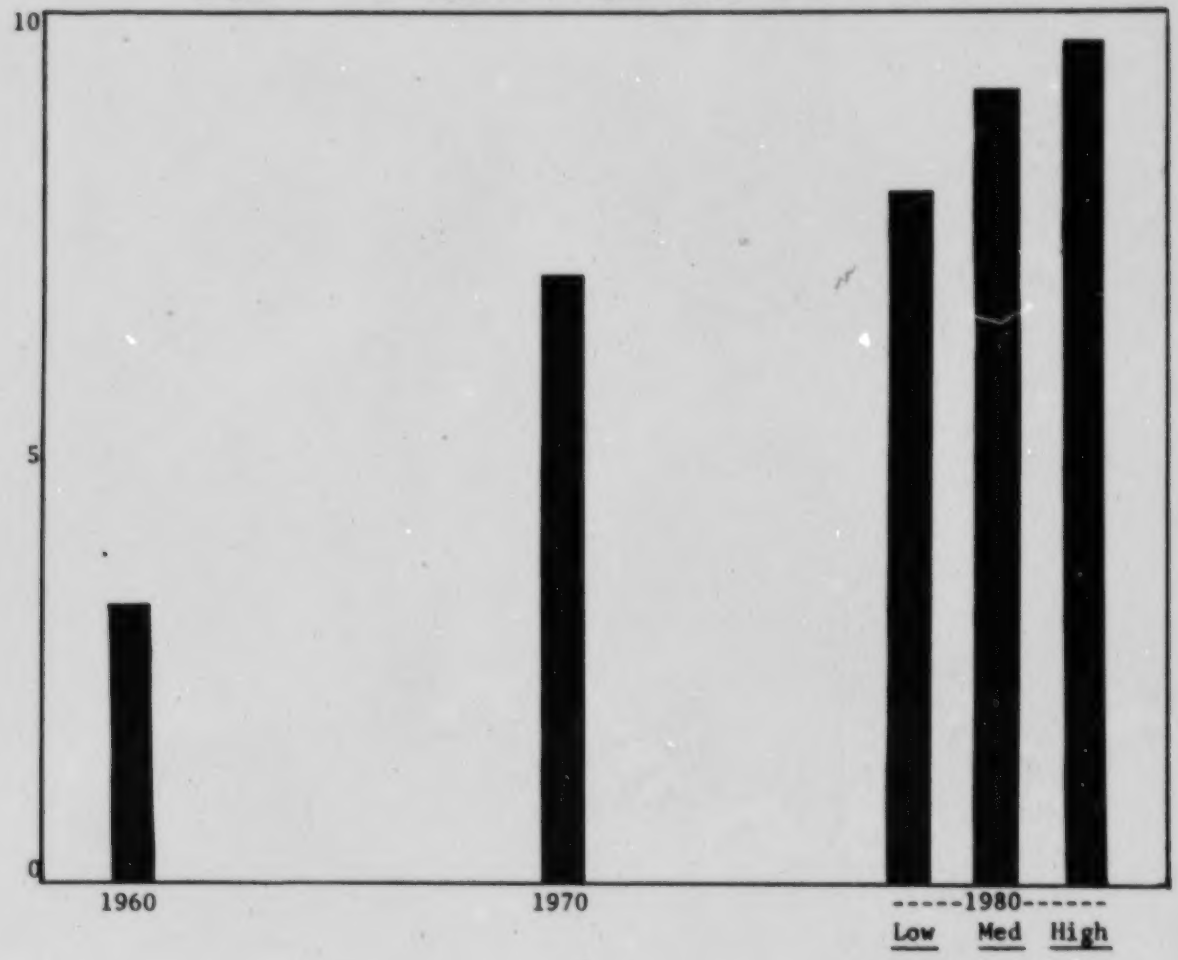

Table 7 -- Undergraduate Degree Credit Enrollment, U.S.

(Millions)

	1960	1970	1980 Low	1980 Medium	1980 High
Enrollment	3.2	7.0	8.0[1]	9.1[2]	9.7[3]
Persons Age 18-21	9.7	14.6	16.7	16.7	16.7
Percent Enrolled	33.0	48.0	48.0	54.5	58.1

1. Assumes that the proportion of those aged 18-21 who are enrolled in degree-credit programs levels off at 48 percent. The proportion was 48.0 percent in 1970, 48.0 percent in 1971 and 47.4 percent in 1972.

2. Projection by U.S. Bureau of the Census in "Projections of School and College Enrollment: 1971 to 2000," Series P-25, No. 473, January, 1972. Series E-3.

3. Projection by the U.S. Office of Education, "Projections of Educational Statistics to 1981-82," 1972 Edition, DHEW Publication No. (OE) 73-11105.

The U. S. Office of Education has projected that the number of bachelor's degrees awarded in 1980-1 will be 45 percent higher than in 1970-1. However, recent trends indicate that the increase may be as low as 12 percent.

Figure 8 -- Bachelor's Degrees, Projection of Current Trends

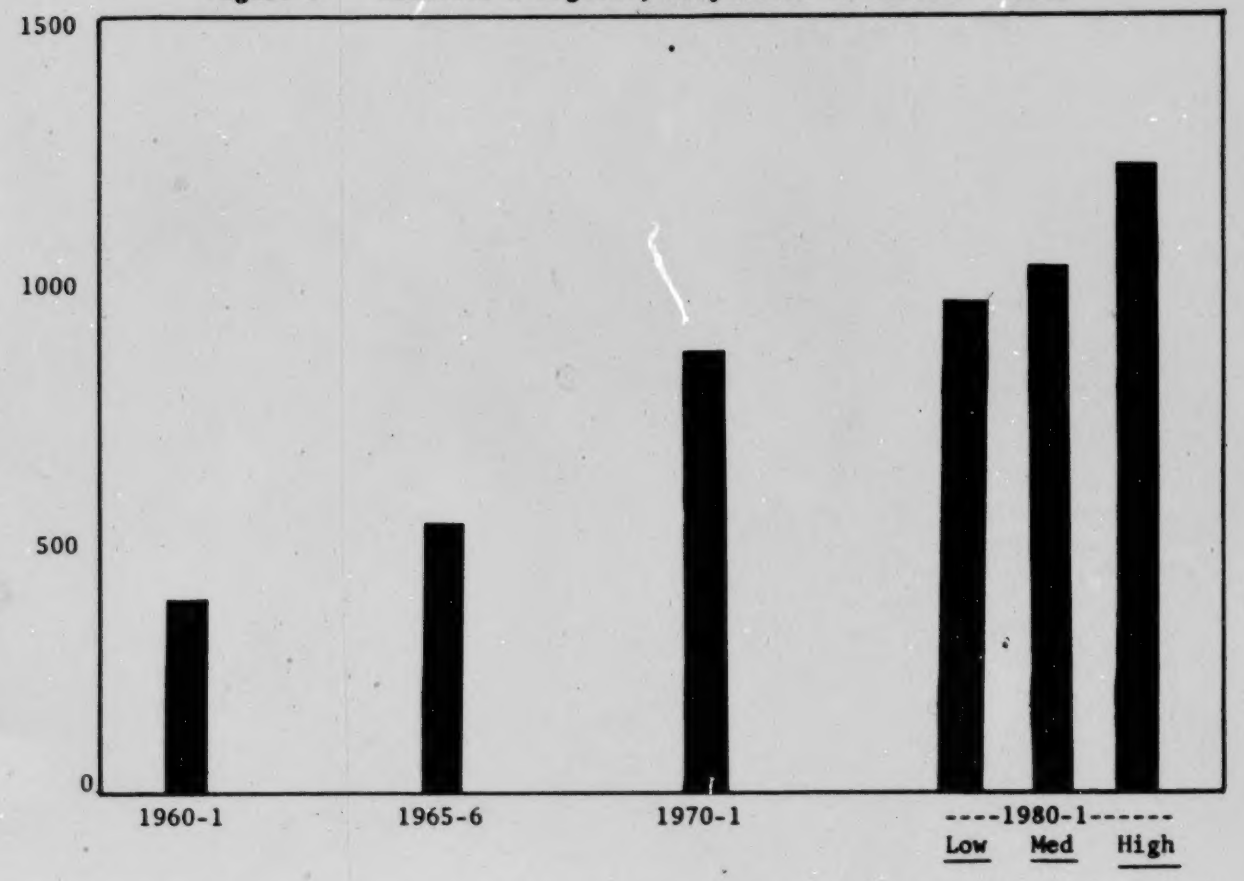

Table 8 -- Bachelor's Degrees, Projection of Current Trends, U.S.

(000)

	1960-1	1965-6	1970-1	1980-1		
				Low	Medium	High
Degrees	369	520	840	945[1]	1,024[2]	1,221[3]
High School Graduates 4 Years Earlier	NA	1,925	2,679	3,390	3,390	3,390
First-Time Degree Enrollment 4 Years Earlier	NA	1,030	1,439	1,783	1,932	2,142
Percentage of High School Graduates Enrolled 4 Years Earlier	NA	53.5	53.7	52.6	57.0	63.2

1. Assumes that percentage of high school graduates enrolling in college, which declined from a peak of 61.6 in 1969 to 57.1 in 1972, will decline to 52.6 in 1977.

2. Assumes that proportion of high school graduates enrolling in college will level off at 57 percent.

3. USOE projection of number of degrees to be awarded in 1980-1.

Source of historic data and "high" 1980 projection: U.S. Office of Education, "Projections of Educational Statistics to 1981-2," 1972 Edition, DHEW Publication No. (OE) 73-11105.

Projected trends in degrees and manpower indicate that substantial shortages of college graduates will occur before 1980; positions would be filled by less qualified personnel, and progress in educational upgrading of the labor force would be slowed significantly.

Figure 9 -- Bachelor's Graduate Supply and Demand in the 70's, U. S.

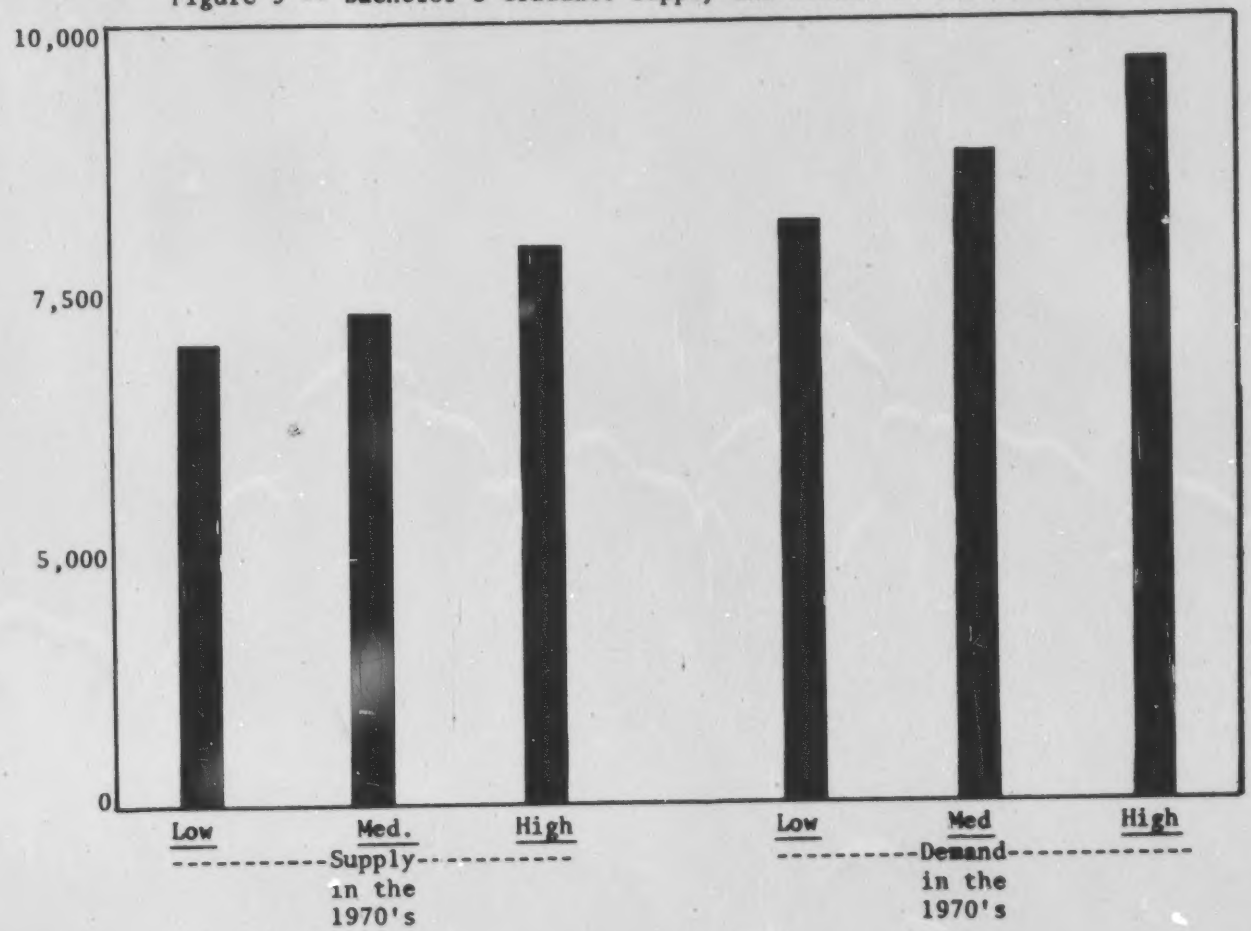

Table 9 -- Bachelor's Graduate Supply and Demand in the 70's, U.S.

(000)

	Low	Medium	High
Supply[1]	6,955	7,260	7,840
Demand	8,080[2]	8,710[2]	9,600[3]

1. Based on projections of degrees awarded (see Table 8).

2. Based on projections of number of college graduates needed in 1980 (see Table 5).

3. Estimate by U.S. Department of Labor.

NOTE: Assumes that 77.9 percent of all college graduates will enter the labor force, the same as in 1971. (Source: U.S. Department of Labor.)

To meet the projected demand for college graduates, and considering the reduced growth in number of degrees which will be earned through 1975-6, the number of college graduates needed by 1980 will be at least one-third higher than in 1970, and quite possibly 55 percent higher.

Figure 10 -- Bachelor's Degrees Needed, U. S.

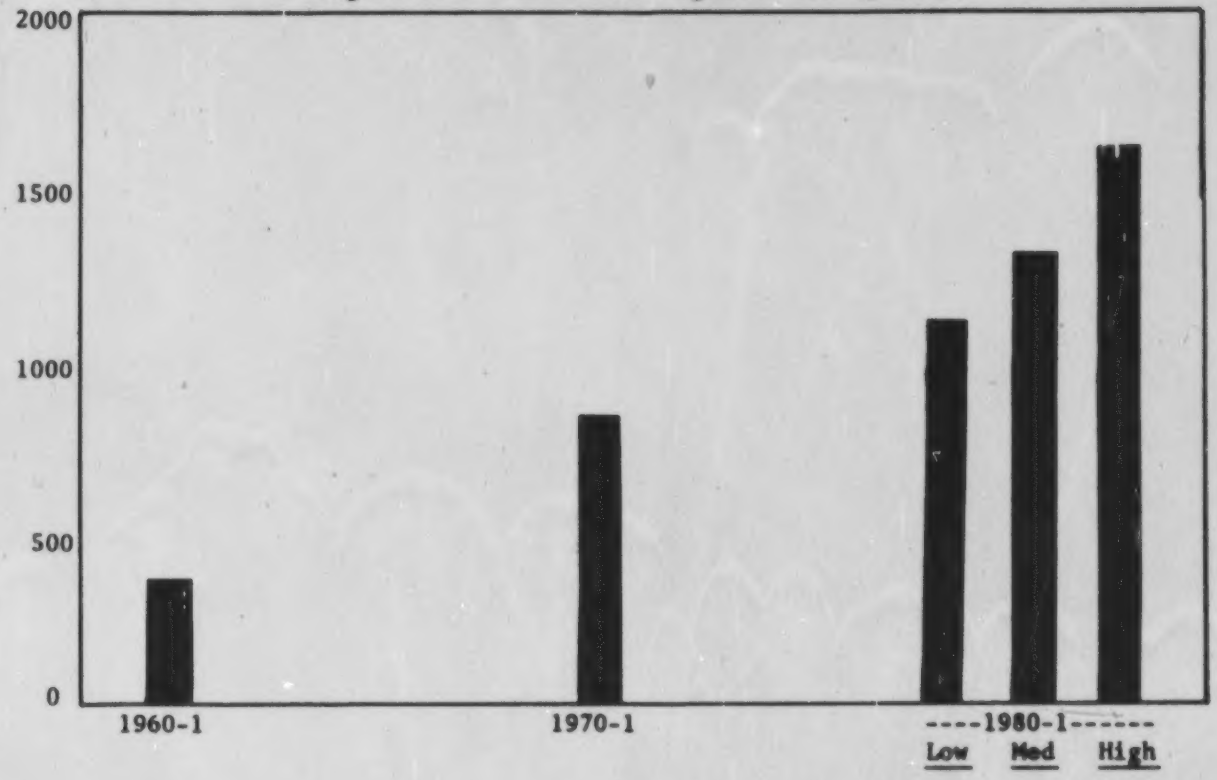

Table 10 -- Bachelor's Degrees Needed, U.S.

(000)

	1960-1	1970-1	1980-1 Low	1980-1 Medium	1980-1 High
Degrees	369	840	1,115	1,305	1,605
Percent Increase	-	-	32.8	55.6	91.0

SECTION II

Scientists and Engineers and Science and Engineering Degrees

United States

Despite publicity about unemployment of scientists and engineers, unemployment among these groups was lower in 1971 -- at the depth of the recession -- than unemployment among all professional and technical workers, and much lower than for the total work force.

Figure 11 -- Unemployment Rates By Manpower Category, 1971, U. S.

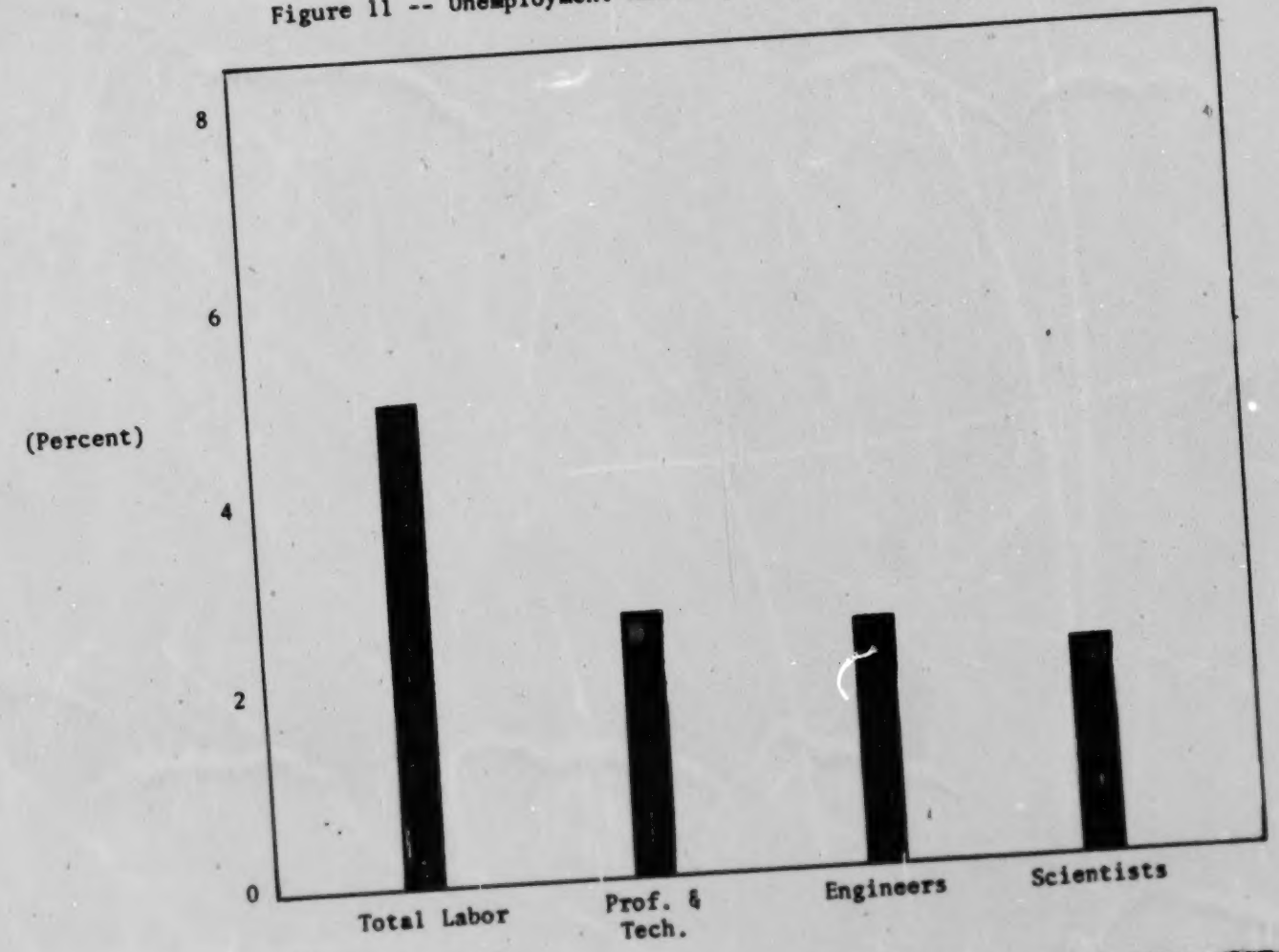

Table 11 - Unemployment Rates by Manpower Category, 1971, U.S.

	Unemployment Rate
Total Labor Force	5.9%
Professional and Technical Workers	3.2%
Engineers	3.0%
Scientists	2.6%

Sources: National Science Foundation, U.S. Department of Labor.

Unemployment of agricultural scientists and foresters in 1971 was the lowest among all fields of science.

Figure 12 -- Scientists' Unemployment Rates, Selected Fields, 1971, U. S.

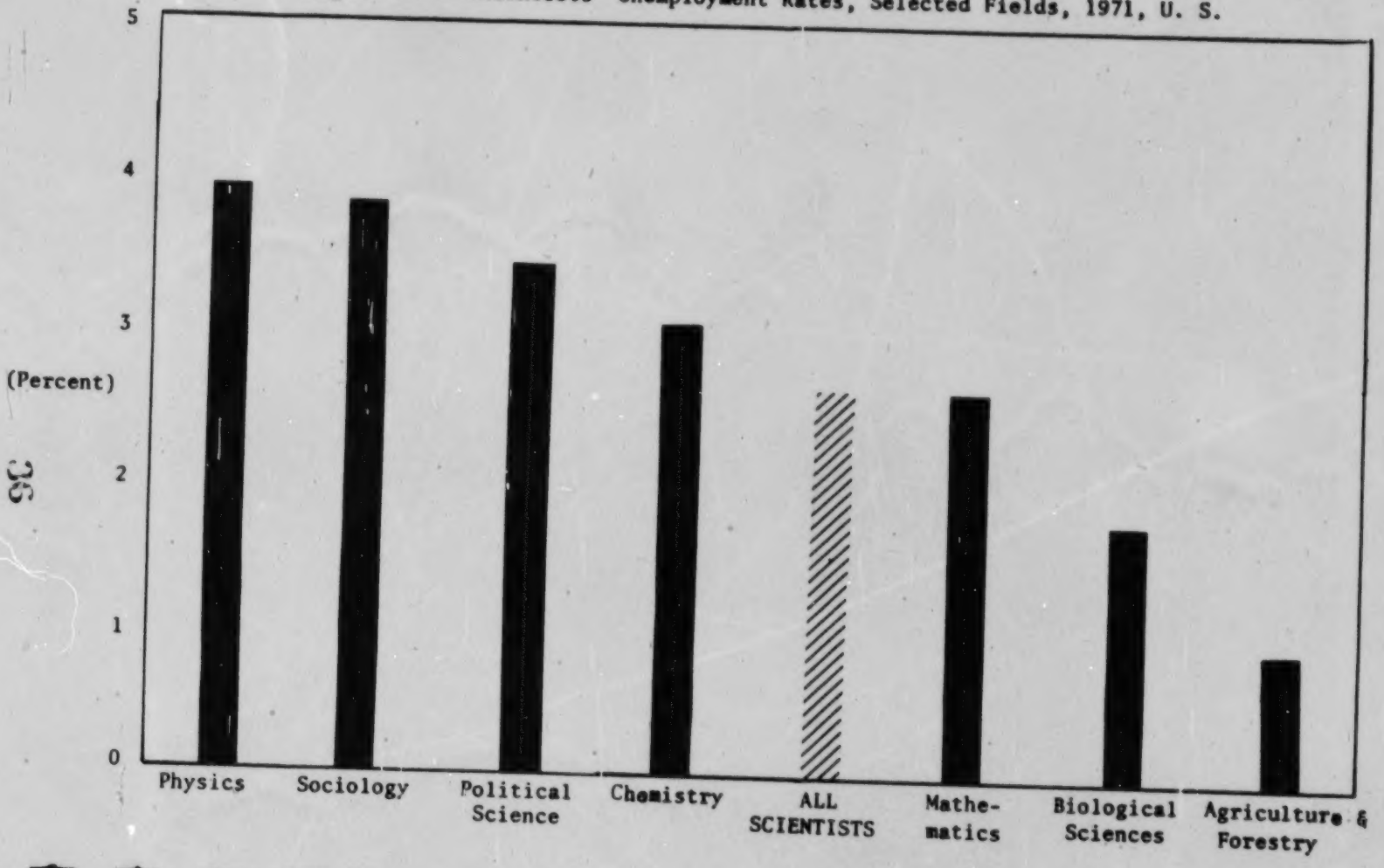

Table 12 -- Scientists' Unemployment Rates, by Field, 1971, U.S.

Field	Rate (Percent)
Linguistics	4.5
Physics	3.9
Sociology	3.8
Computer Sciences	3.6
Political Science	3.4
Chemistry	3.0
Atmospheric and Space Science	2.8
Earth and Marine Science	2.7
ALL SCIENTISTS	2.6
Mathematics	2.6
Statistics	2.2
Biological Sciences	1.7
Economics	1.6
Psychology	1.6
Anthropology	1.3
Agriculture (including forestry)	0.9
Forestry	0.7

Source: National Science Foundation, "Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971," NSF 72-307, 1972.

Unemployment among scientists and engineers in 1971 was the highest on the East and West Coasts. Unemployment in Ohio was well below the national average.

Figure 13 -- Scientists' and Engineers' Unemployment Rates, Selected States, 1971, U. S.

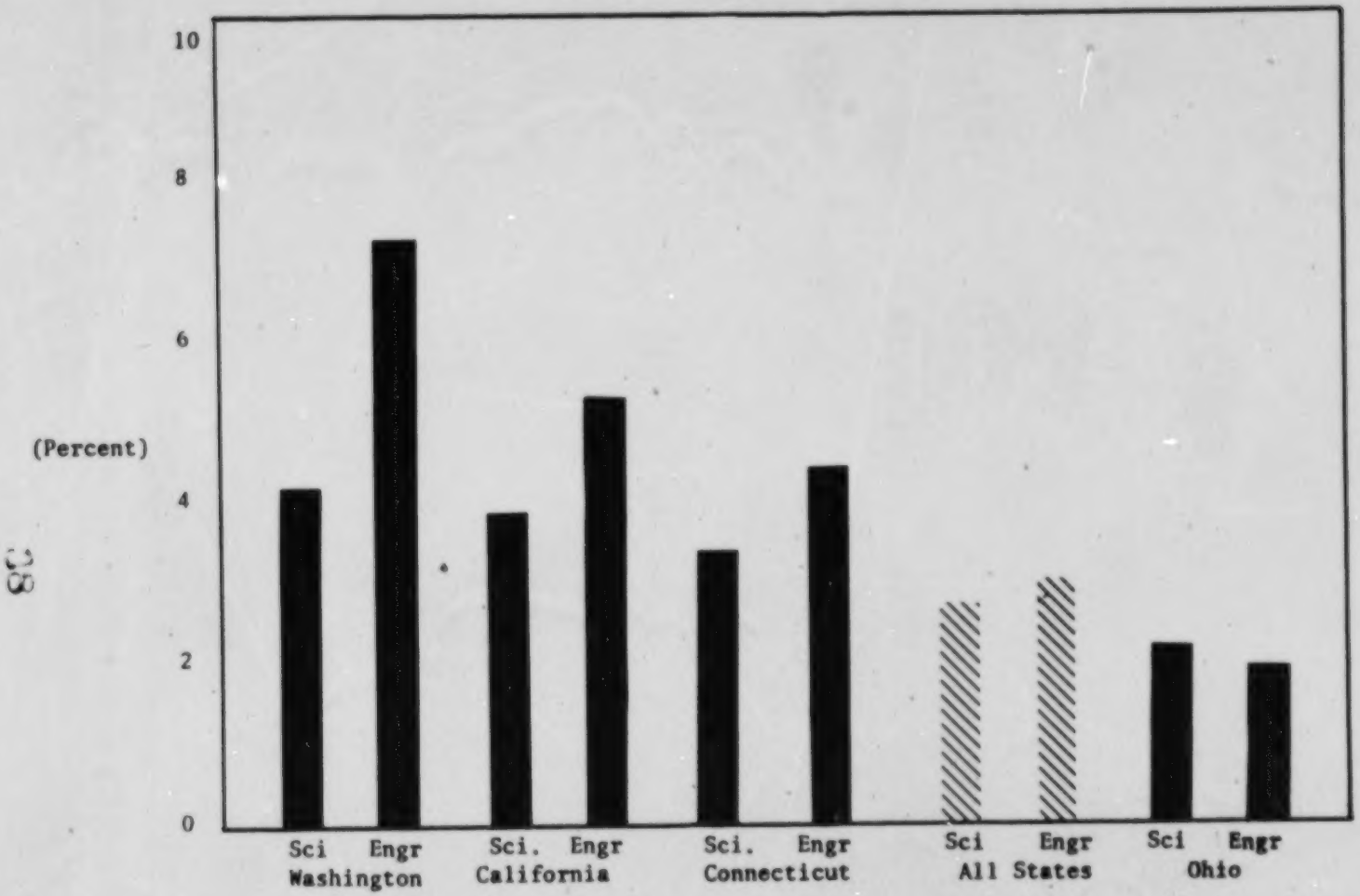

Table 13 -- Scientists' and Engineers' Unemployment Rates, Selected States, 1971, U.S.

(Percent)

State	Scientists	Engineers
Washington	4.2	7.3
California	3.8	5.3
Connecticut	3.4	4.4
Massachusetts	3.4	4.3
Arizona	3.1	4.4
ALL STATES	2.6	3.0
Ohio	2.1	1.9

Source: National Science Foundation, "Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971," NSF 72-307, 1972.

Engineer unemployment in 1971 was highest among those in the space and defense industries.

Figure 14 -- Unemployment of Engineers by Previous Areas of Work, 1971, U. S.

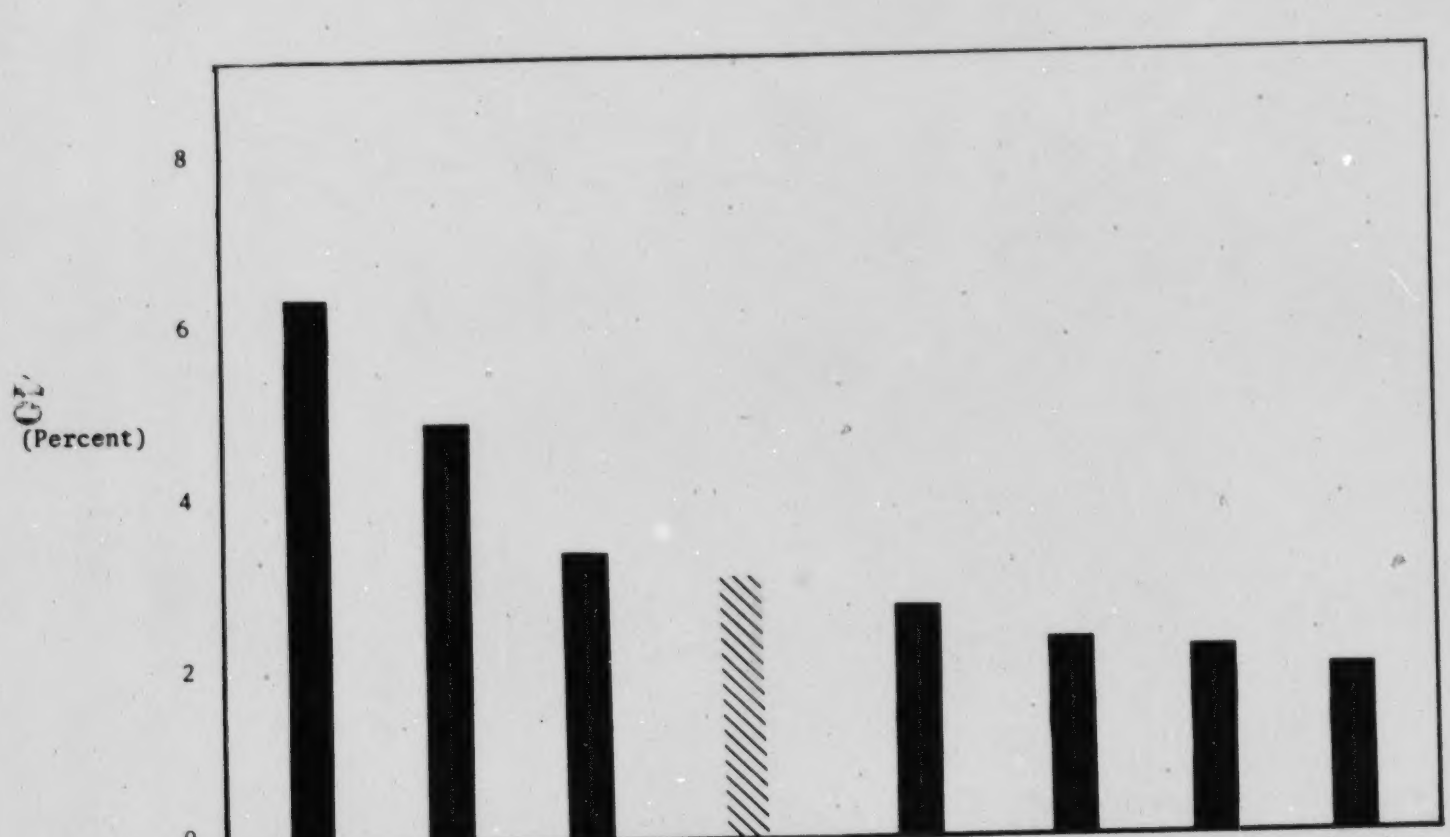

Table 14 -- Unemployment of Engineers by Previous Areas of Work, 1971, U.S.

Area of Previous Employment	Unemployment Rate (percent)
Space	6.3
Defense	4.8
Transportation	3.3
Health	3.1
ALL ENGINEERS	3.0
Industrial Products and Processes	2.6
Consumer Products	2.3
Education	2.3
Pollution	2.2
Atomic Energy	1.9
Urban Development	1.8
Miscellaneous	1.4
Public Works	1.3

Source: National Science Foundation, "Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971," NSF 72-307, 1972.

The slowdown in research and development spending during the past several years is believed to be only temporary; research and development expenditures will pass $40 billion by 1980, compared with $28 billion in 1972.

Figure 15 -- Total Research and Development Expenditures

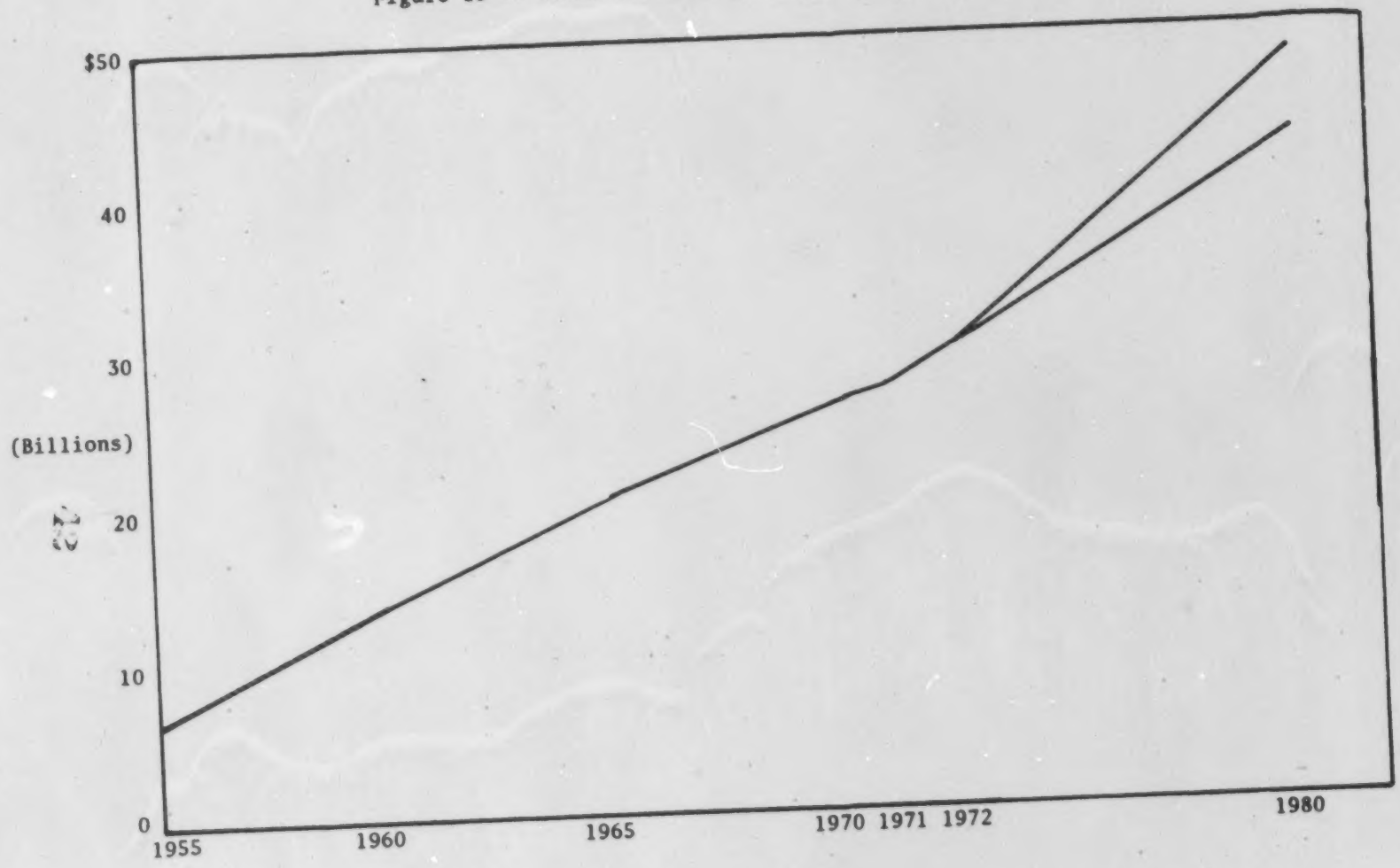

Table 15 -- Total Research and Development Expenditures, U.S.

(Billions)

	1955	1960	1965	1970	1971	1972	1980 Low	1980 High
Gross National Product	$397.5	$502.6	$684.9	$976.4	$1050.4	$1151.8	----$1600[1]----	
R & D Expenditures	$6.3	$13.7	$20.4	$26.6	$27.3[2]	$29.2[3]	$43.2	$48.0
Percent of GNP	1.6	2.7	3.0	2.7	2.6	2.5	2.7	3.0

1. 1971 dollars.
2. Preliminary
3. Estimated.

Source: National Science Foundation, "National Patterns of R & D Resources, Funds and Manpower in the United States, 1953-1973," NSF 73-303, 1973; and National Science Foundation, "1969 and 1980 Science and Engineering Doctorate Supply and Utilization," NSF 71-20, May, 1971.

Non-defense and space research and development expenditures have grown rapidly since the mid-sixties, and are expected to more than double during the 1970's.

Figure 16 -- Research and Development Expenditures by Major Category, U. S.

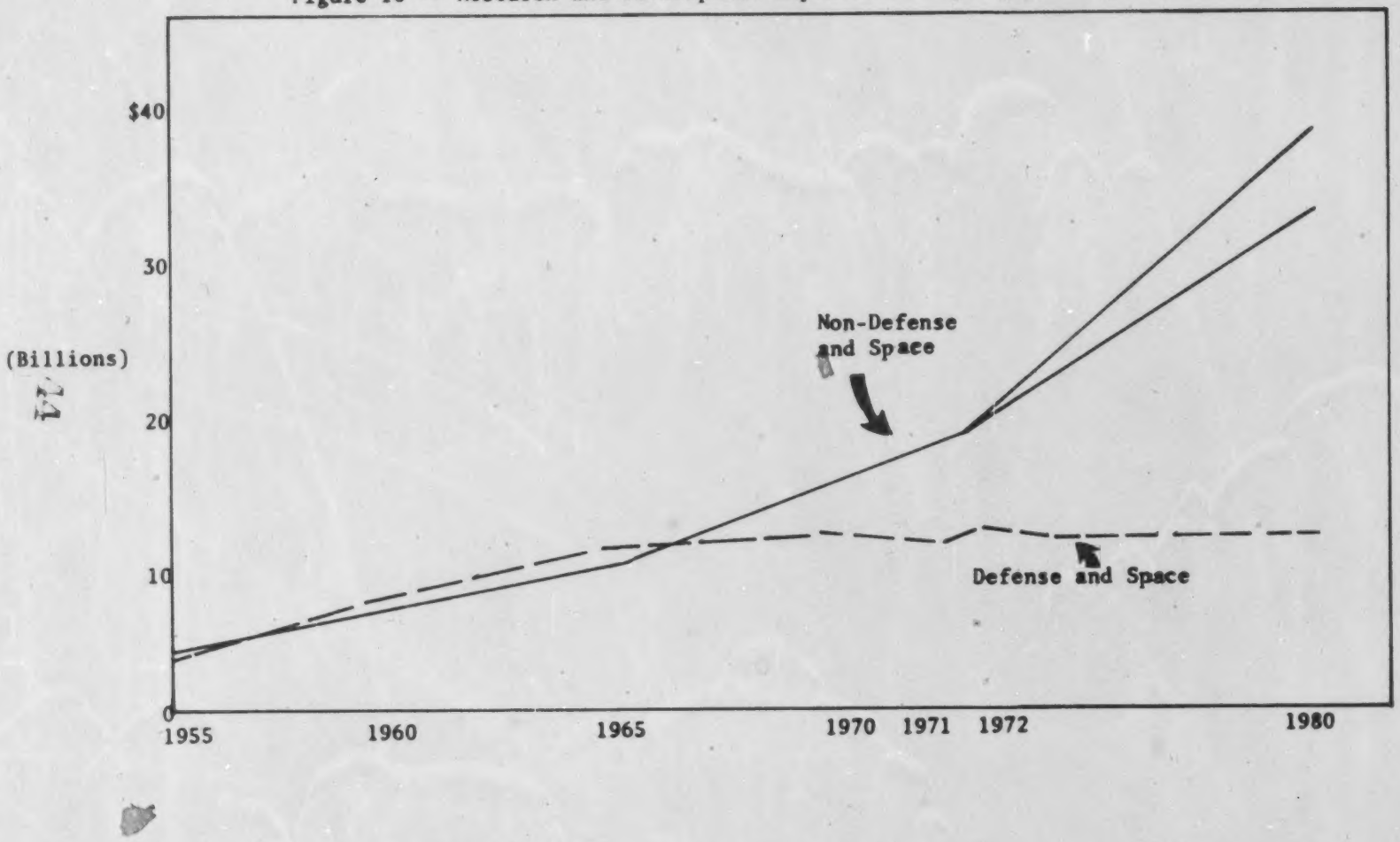

Table 16 -- Research and Development Expenditures by Major Category, U.S.

(Billions)

	1955	1960	1965	1970	1971	1972	1980[1] Low	1980[1] High
Defense and Space	$3.0	$ 7.5	$10.8	$11.4	$11.0	$11.5	----$11.0----	
All Other	$3.3	$ 6.2	$ 9.6	$15.2	$16.3	$17.7	$32.2	$37.0
TOTAL	$6.3	$13.7	$20.4	$26.6	$27.3	$29.2	$43.2	$48.0
Percent "All Other" of Total	51.6	45.3	47.3	56.9	59.8	60.5	74.8	77.0

1. 1971 dollars.

Source of Historic Data and Total Expenditures for 1980: National Science Foundation (see Table 15).

The rising level of research and development expenditures will mean a need for 50 to 85 percent more research and development scientists and engineers in 1980, compared with 1970.

Figure 17 -- Scientists and Engineers Engaged in Research & Development, U. S.

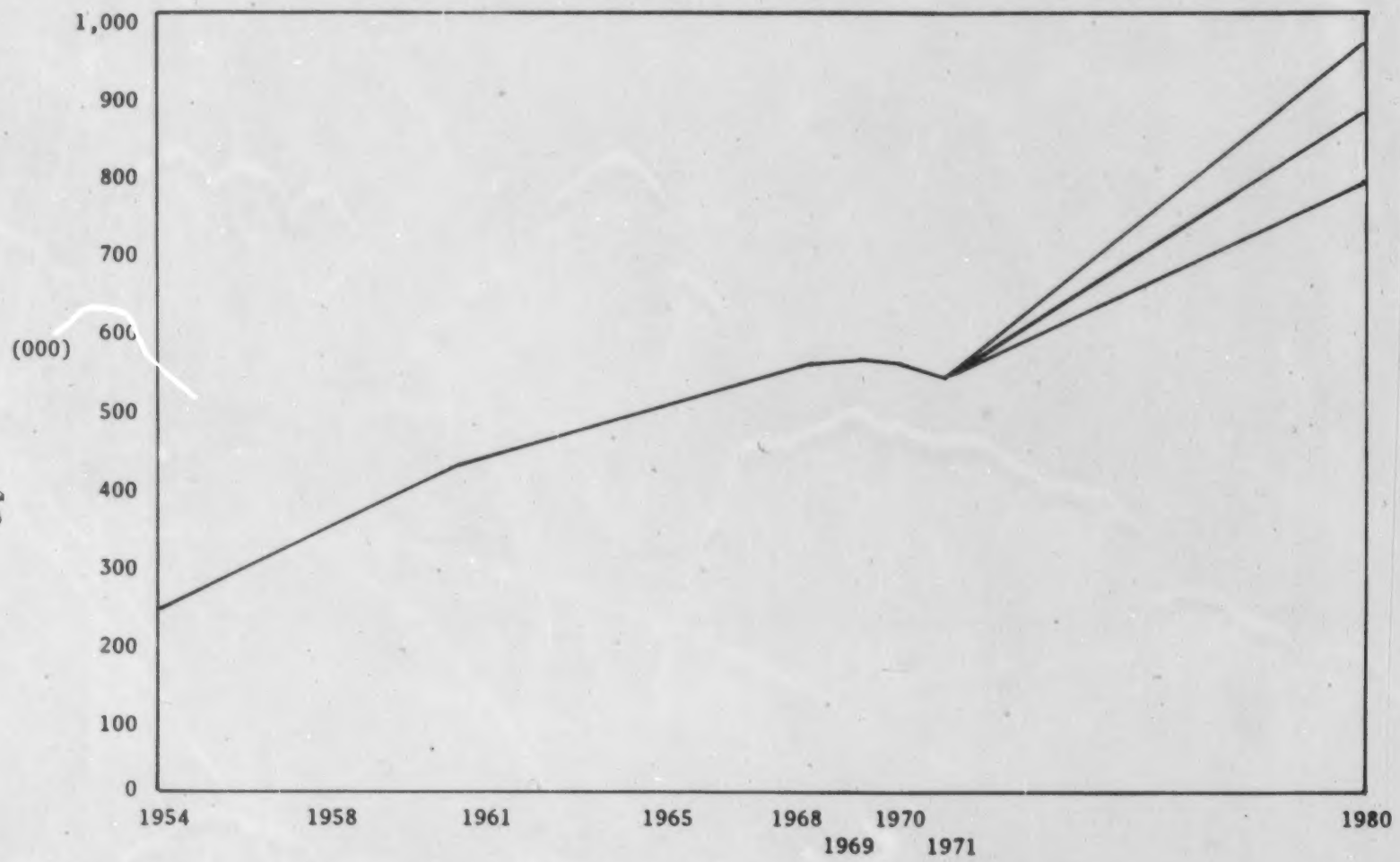

Table 17 -- Research and Development Manpower and R & D Costs, U.S.

	1954	1958	1961	1965	1968	1969	1970	1971	1980[1] Low	1980[1] High
R & D Expenditures (billions)	$ 8.6	$15.3	$19.8	$26.2	$29.3	$29.0	$26.6	$27.3	$43.2	$48.0
R & D Scientists and Engineers (000)	236.8	354.7	425.2	496.5	550.6	559.4	549.6	532.8	785-864	873-960
Expenditure per Individual (000)	$44.6	$43.1	$46.6	$52.8	$53.2	$51.8	$48.4	$51.2	$50.0-$55.0	$50.0-$55.0

1. 1971 dollars.

Source of Historic Data and 1980 R & D expenditures: See Table 15.

Total need for scientists and engineers in the U. S. will be one-third to two-thirds higher in 1980 than in 1970.

Figure 18 -- Science and Engineering Manpower Levels, U. S.

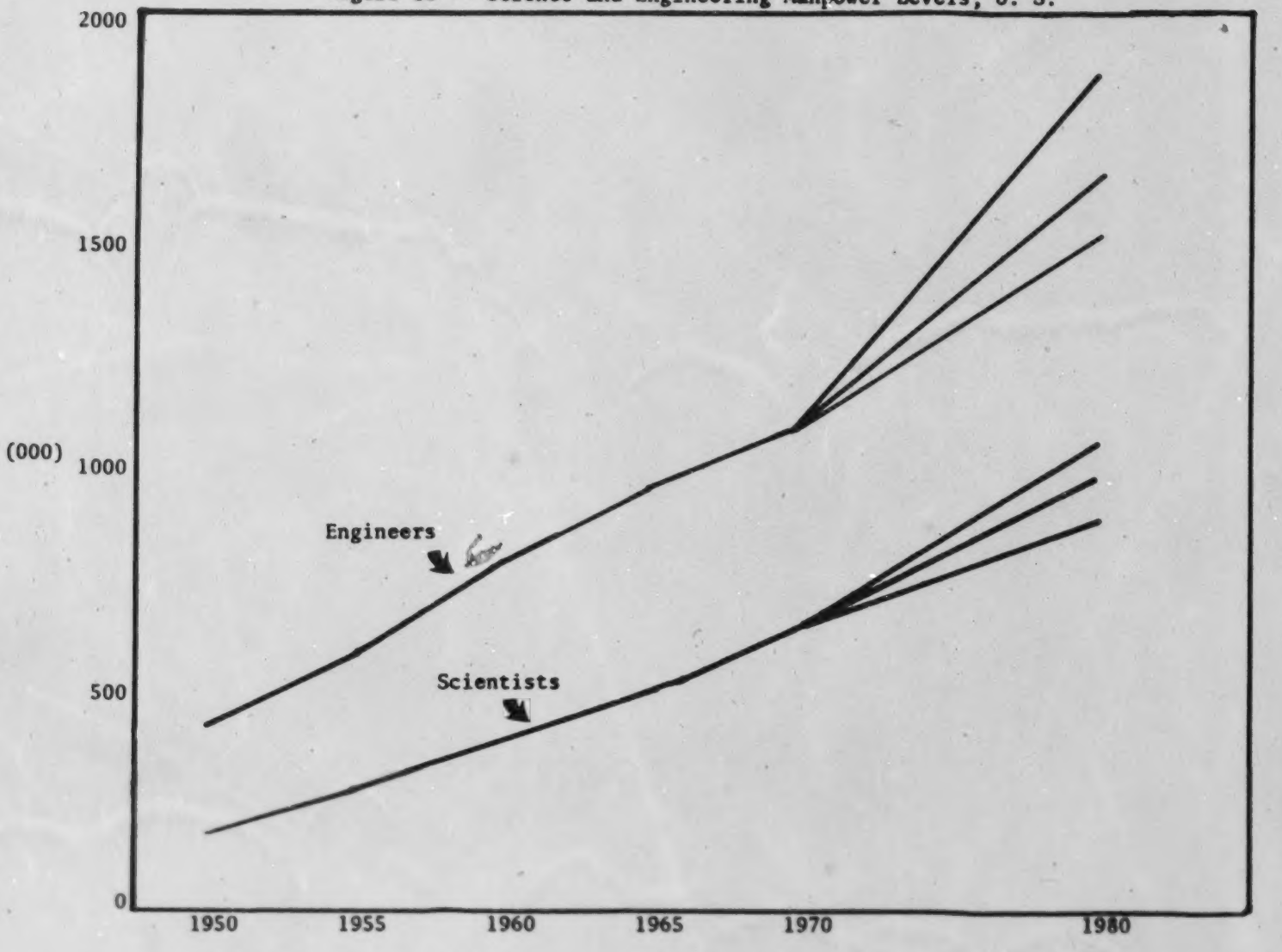

Table 18 -- Science and Engineering Manpower Levels, U.S.

(000)

	1950	1955	1960	1965	1970	1980 Low[1]	1980 Medium[2]	1980 High[2]
Natural Scientists[3]	146.3	208.5	300.5	395.5	509.0	702.4	756.9	841.9
Percent increase over 1970						38.0	48.7	65.4
Social Scientists[4]	36.3[5]	51.7[5]	74.5[5]	98.1[5]	126.0	170.0	187.4	208.4
Percent increase over 1970						34.9	48.7	65.4
TOTAL Scientists	182.6	260.5	375.0	493.6	635.0	872.4	944.3	1050.3
Percent increase over 1970						37.4	48.7	65.4
Engineers	404.6	597.8	796.7	965.8	1100.0	1500.0	1635.7	1819.4
Percent increase over 1970						36.4	48.7	65.4
TOTAL Scientists and Engineers	587.2	858.3	1171.7	1459.4	1735.0	2372.4	2580.0	2869.7
Percent increase over 1970						36.7	48.7	65.4

1. Source: National Science Foundation, unpublished data.
2. Based on projected growth in R & D scientists and engineers (see Table 17).
3. Physical and life scientists, and mathematicians.
4. Economists, statisticans, historians, sociologists, political scientists, geographers, anthropologists, etc.
5. Estimated - same percentage of natural scientists as in 1970.

If recent trends continue, bachelor's degrees granted in the social sciences will increase from one-third to two-thirds during the 1970's, while bachelor's degrees granted in the natural sciences will increase only modestly, if at all, and bachelor's degrees granted in engineering will drop off sharply.

Figure 19 -- Bachelors' Degrees Granted in Science and Engineering, U. S.

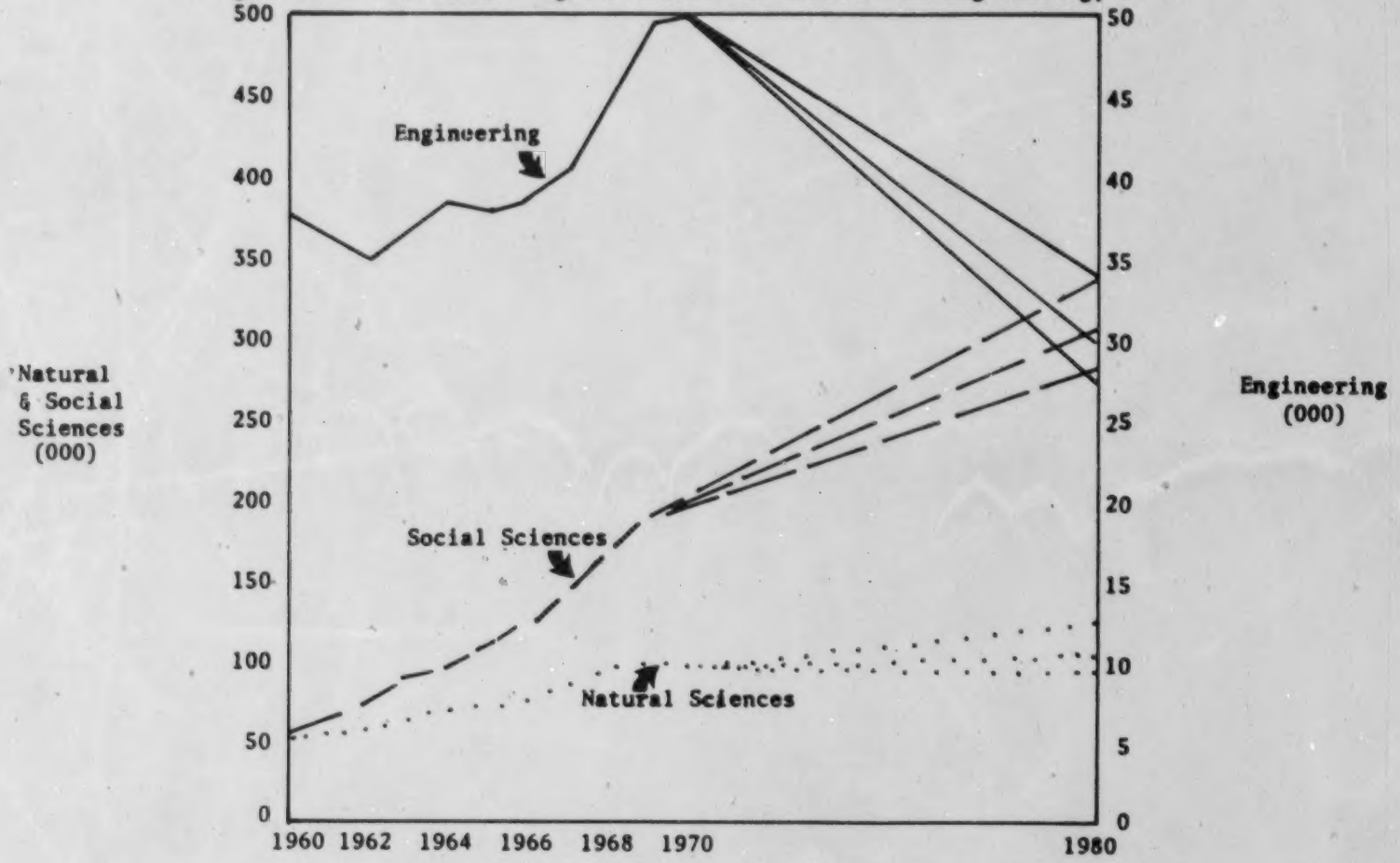

Table 19 -- Bachelor's Degrees Granted in Science and Engineering, U.S.[1]

(000)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1980 Low	1980 Medium	1980 High
Total Degrees, All Fields	368.9	387.8	416.4	466.5	501.2	520.2	558.1	631.9	728.2	791.5	839.7	945.0[2]	1024.0[2]	1221.0[2]
Degrees in Natural Sciences[3]	50.7	53.7	57.9	65.5	69.7	71.6	76.3	84.0	95.6	99.8	97.0	94.5[4]	102.4[4]	124.8[5]
Percent of Total	13.7	13.8	13.9	14.0	13.9	13.8	13.7	13.3	13.1	12.6	11.5	10.0[4]	10.0[4]	10.2[5]
Degrees in Social Sciences[6]	60.2	66.5	76.0	90.1	99.2	110.7	124.4	145.9	172.6	190.4	205.9	283.5[4]	307.2[4]	339.3[5]
Percent of Total	16.3	17.1	18.3	19.3	19.8	21.3	22.3	23.1	23.7	24.1	24.5	30.0[4]	30.0[4]	27.8[5]
Degrees in Engineering	37.5	36.1	35.0	37.0	38.5	38.0	38.7	40.5	45.5	49.7	50.0	27.5[7]	30.0	34.0[7]
Percent of Total	9.0	8.4	7.5	7.1	6.9	6.5	6.1	5.6	5.4	5.4	5.1	2.9	2.9	2.8

1. For the academic year starting in the year indicated.

2. From Table 8.

3. Mathematics and statistics, physical sciences, biological sciences, agriculture and natural resources, computer and information sciences.

4. Projection of past trends.

5. U.S. Office of Education Projection("Projection of Educational Statistics to 1980-82").

6. Psychology, anthropology, economics, geography, history, political science, public administration, sociology and other social sciences.

7. Based on the rapid decline during the past several years in freshmen enrollments. The sharp decline indicated that the number of degrees awarded will drop to 27,500 by 1975-6. The medium and high projections allow for a gradual recovery. (Note: U.S. Office of Education's latest estimate shows engineering degree unchanged from 1970 to 1980.) Source: Mrs. Betty Vetter, Scientific Manpower Commission, Washington, D.C. and the Engineers' Joint Council, New York, N.Y.

Source of historic and high 1980 projections: U.S. Office of Education, "Projection of Educational Statistics to 1980-82."

Supply of natural scientists will fall short of demand in 1980 if the current projections of degrees are correct. Therefore, the number of degrees must increase at least 30 percent (high projection) to meet medium level of demand.

Figure 20 -- Supply and Demand of Natural Scientists, 1980, U. S.

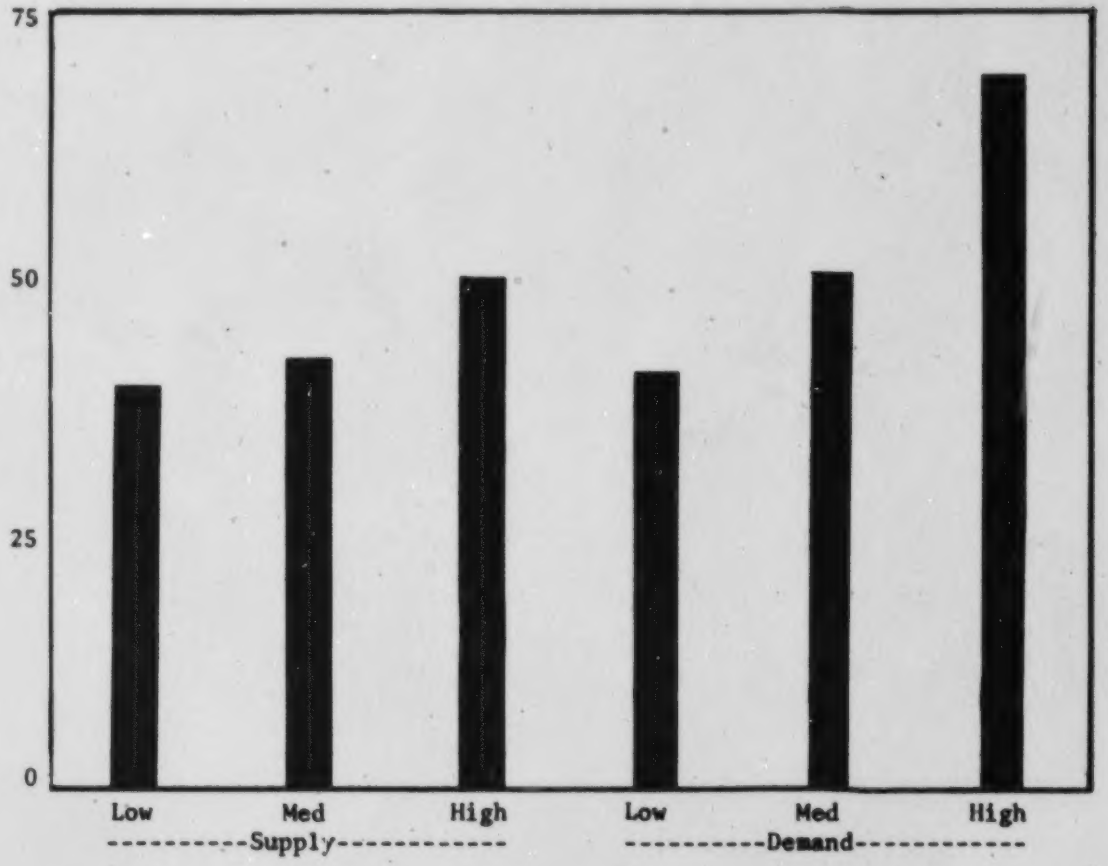

Table 20 -- Supply of and Demand for Natural Scientists, 1980, U.S.

(000)

	Low	Medium	High
Demand[1]	40.1	49.9	62.8
Supply[2]	37.8	41.0	49.9
Total Degrees, all natural science disciplines	94.5	102.4	124.8

1. Annual growth plus replacement at 2.5 percent of 1980 projection shown in Table 18.

2. Assumes that 40 percent of those receiving degrees will be available for employment in positions described as "scientist" (1965-70 average was 40 percent).

Note: 2.5 percent replacement rate is based on normal 40-year career span. It is assumed that transfers out of the field will offset a lower replacement rate accounted for by the relative youthfulness of natural scientists. Also, differences in supply-demand situations for individual fields within the natural sciences are not considered in these gross calculations. See Table 28 for a more detailed breakdown for Ph.D. scientists.

Trends in degrees in the social sciences indicate that a sufficient number of graduates should be available to meet the needs for social scientists in 1980.

Figure 21 -- Degree and Employment Trends in the Social Sciences, U. S.

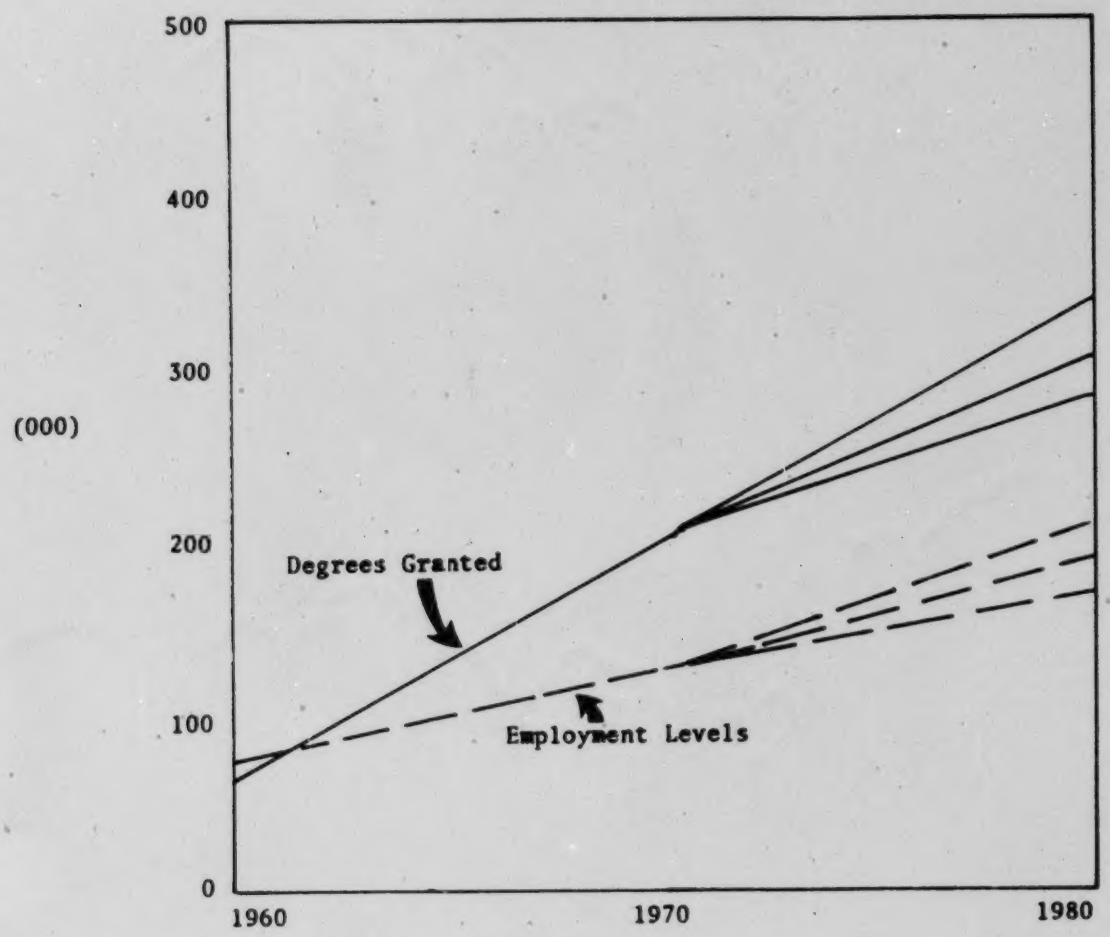

Table 21 -- Degree and Employment Trends in the Social Sciences, U.S.

(000)

	1960	1970	1980 Low	1980 Medium	1980 High
Employment Level	74.5	126.0	170.0	187.4	208.4
Bachelor's Degrees Granted	60.2	205.9	283.5	307.2	339.3

Note: Only a small percentage of those receiving degrees in fields categorized as "social science" enter positions which are identified as "social scientists." Therefore, a precise matching of supply and demand is not possible with available data. Also, differences in the supply-demand situations for individual disciplines are not considered in these gross comparisons. See Table 28 for a supply-demand comparison for Ph.D. social scientists.

If present engineering enrollment trends continue, the supply of engineers will fall far short of demand by 1980. Therefore, engineering degrees must, by 1980, increase to at least 50 percent above the 1970 level. This would meet the medium projection of demand.

Figure 22 -- Supply and Demand of Engineers, 1980, U. S.

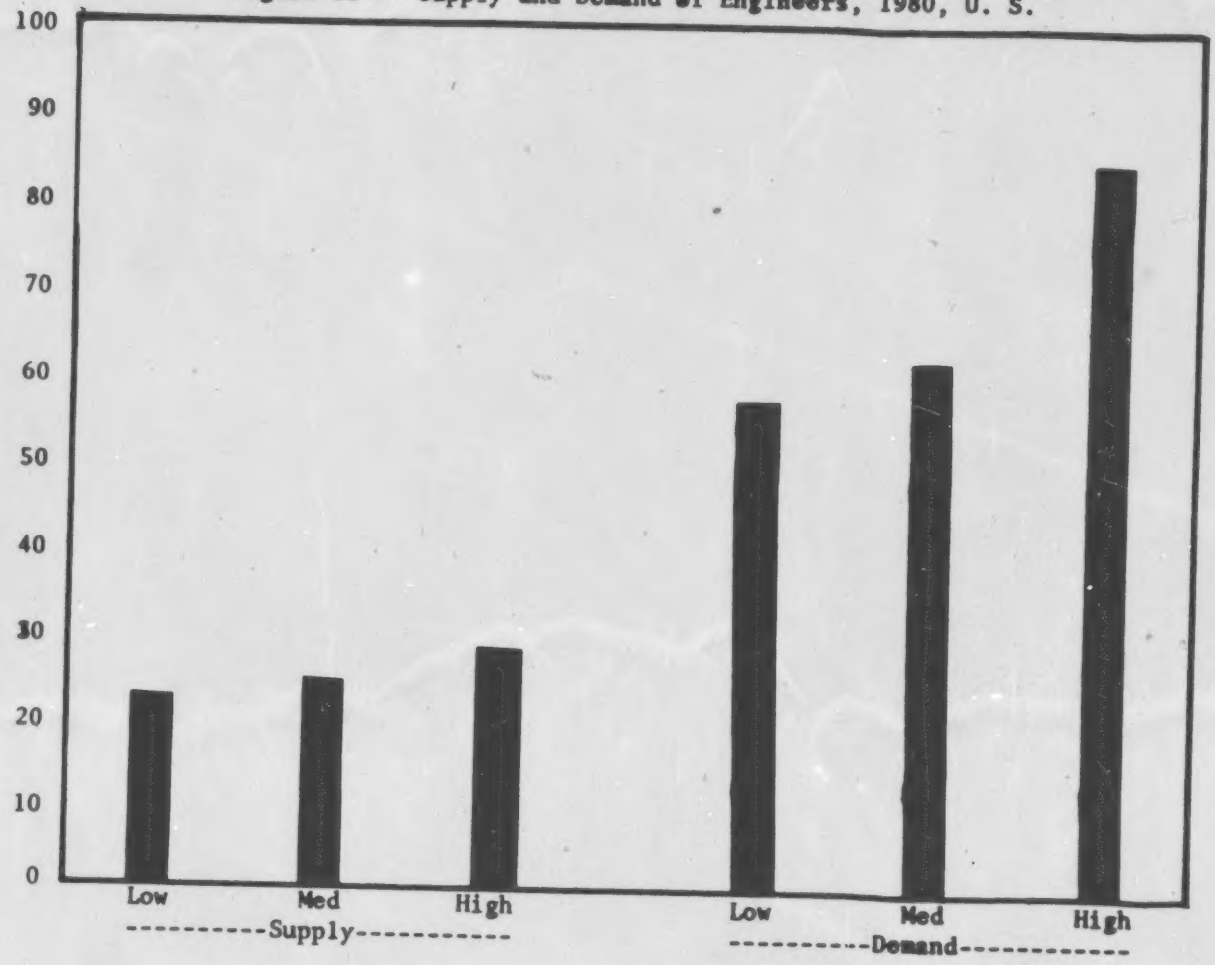

Table 22 -- Supply of and Demand for Engineers, 1980, U.S.

(000)

	Low	Medium	High
Demand[1]	56.3	61.9	85.0
Supply[2]	22.0	24.0	28.0

1. Annual growth plus replacements at 2.5 percent of 1980 projections shown in Table 18, reduced to account for the fact that only about 73 percent of those classified as "engineers" are engineering graduates. Thus, educational upgrading of the engineering work force is not projected.

2. 80 percent of the graduates projected in Table 19.

SECTION III

Ph. D. Scientists and Engineers
and Science and Engineering Doctorates

United States

Scientists and engineers with doctorate degrees had much lower unemployment rates in 1971 than did scientists and engineers with less formal education.

Figure 23 -- Unemployment Rates of Scientists and Engineers, By Highest Degree, 1971, U. S.

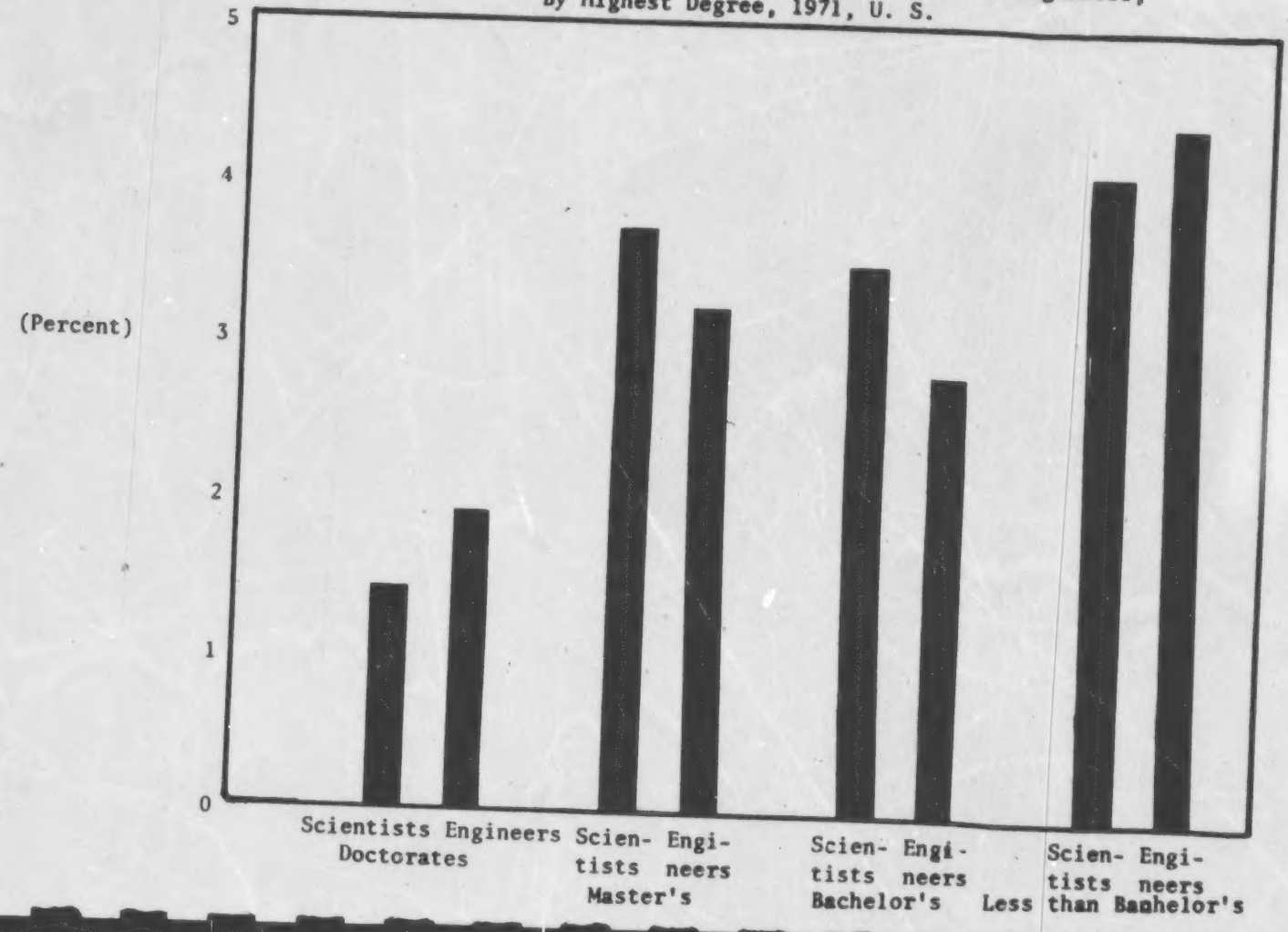

Table 23 -- Unemployment Rates of Scientists and Engineers, by Highest Degree, 1971, U.S.

Highest Degree	Scientists	Engineers
Doctorate	1.4	1.9
Master's	3.7	3.2
Bachelor's	3.5	2.8
Less than Bachelor's	4.1	4.4

Source: National Science Foundation, "Unemployment Rates and Employment Characteristics for Scientists and Engineers, 1971," NSF 72-307, 1972.

Employment of Ph. D. scientists and engineers will increase from 60 to 70 percent by 1980, compared with 1970.

Figure 24 -- Ph.D. Scientists and Engineers -- Manpower Levels, U. S.

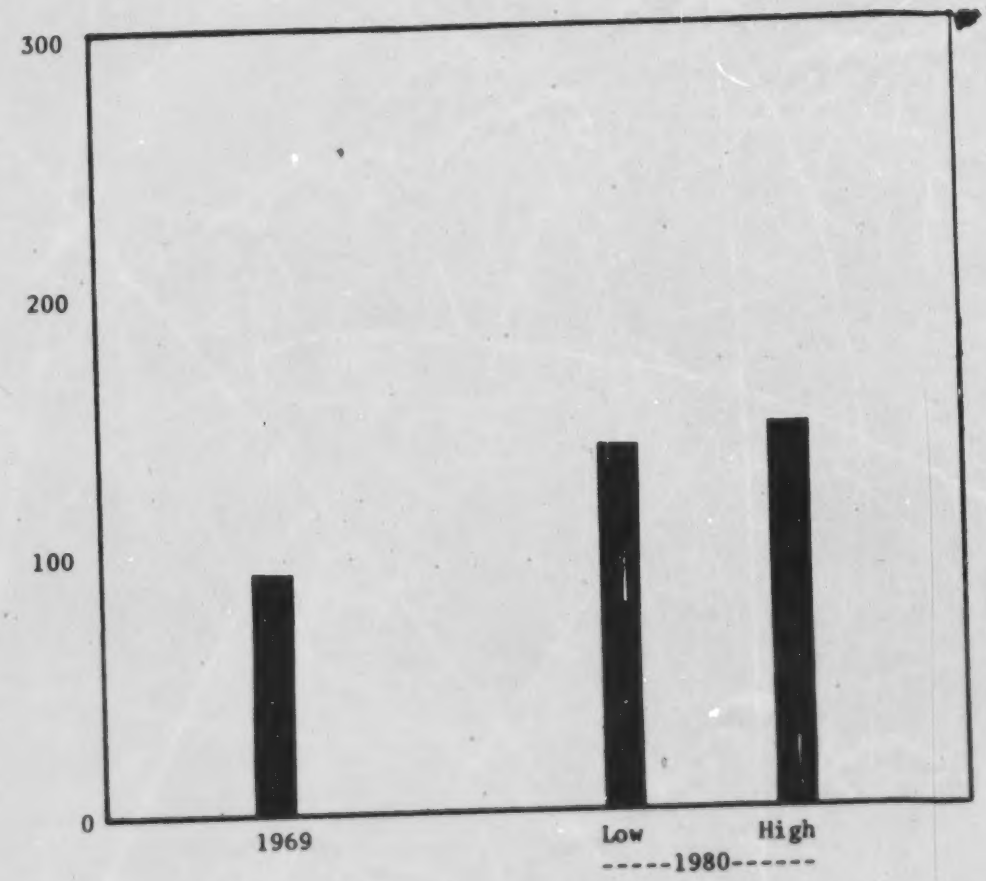

Table 24 -- Ph.D. Scientists and Engineers--Manpower Levels, U.S.

(000)

Employed by:	1969	1980 Low	1980 High
Colleges and Universities	94.3	147.1	148.6
Non-academic Organizations			
Industry	41.2	NA	NA
Government	15.0	NA	NA
Other	7.5	NA	NA
Subtotal	63.7	106.2	132.3
TOTAL	158.0	253.3	280.9
Percent Increase	--	60.3	77.8

Source: National Science Foundation, "1969 and 1980 Science and Engineering Doctorate Supply and Utilization," NSF 71-20, May, 1971.

Production of doctorates in all fields has been estimated to increase by 50 to 100 percent from 1970 to 1980; however, current trends in enrollment and financial support indicate that the number of degrees awarded in 1980 may be slightly lower than the number in 1970.

Figure 25 -- Doctorates Granted, U. S.

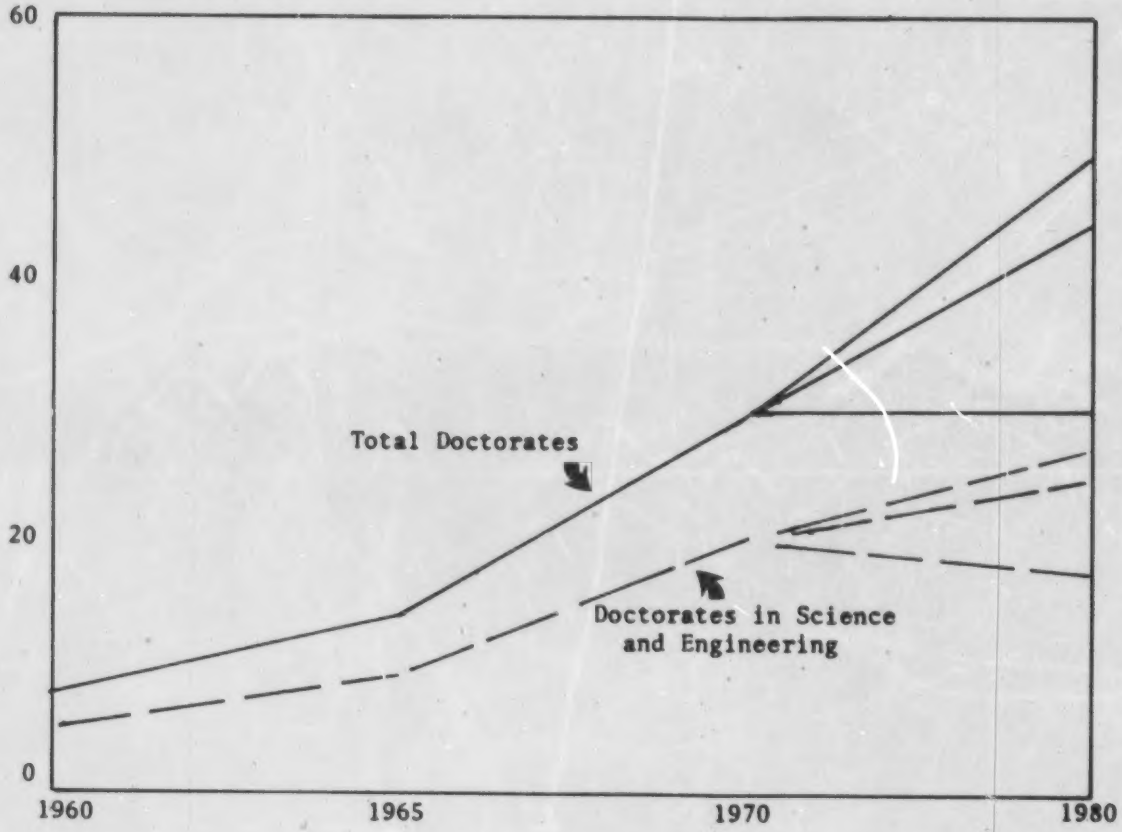

Table 25 -- Doctorates Granted, Total and in Science and Engineering, U.S.

(000)

				1980		
	1960	1965	1970	Low	Medium[2]	High[3]
Total Doctorates	10.6	18.2	32.0	31.4[1]	45.2	52.0
Science[4] and Engineering	7.1	12.1	19.9	17.2[5]	25.8	28.5
Percent of Total	67.0	66.5	62.2	54.8[5]	57.1	54.8

1. Source: Council of Graduate Schools in the United States, "Report on the CGS Doctorate Production Survey," CGS, One Dupont Circle, Washington, D.C., 20036, May 3, 1972. Survey of graduate school deans, who projected degrees to be 31,400 in 1975-6, based on current enrollments. The Council also projected little change between 1975-6 and 1980-1, based on probable trends in financial support and other indicators.
2. Source: National Science Foundation, "1969 and 1980 Science and Engineering Doctorate Supply and Utilization," NSF 71-20, May, 1971.
3. Source: U.S. Office of Education, "Projections of Educational Statistics to 1981-2," 1972 edition, DHEW, No. (OE) 73-11105.
4. Includes both natural and social sciences (as defined in Table 19).
5. Same percentage of science and engineering to total as in USOE projection.

Supply of Ph. D.'s in science and engineering will fall short of demand if current enrollment trends persist; considering the inevitable slowdown through at least 1975-6 the number of Ph. D.'s in science and engineering must, by the late 1970's, be as much as 50 percent above current levels.

Figure 26 -- Supply and Demand for Ph.D. Scientists and Engineers, 1980, U. S.

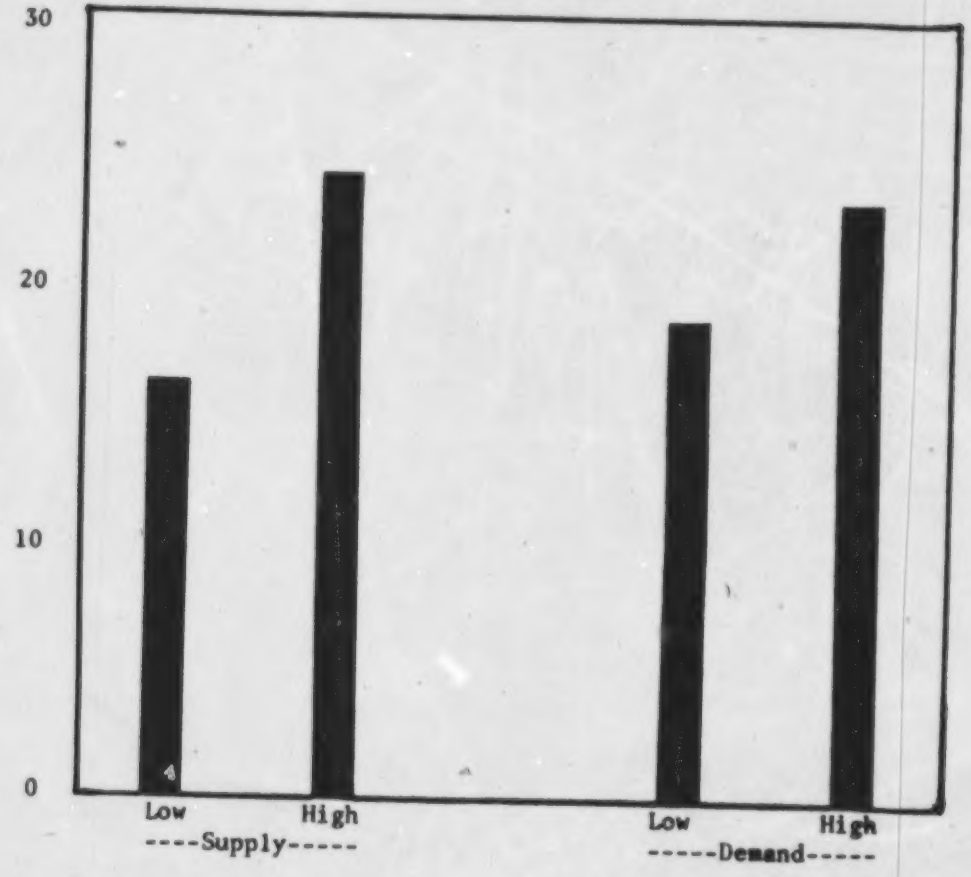

Table 26 -- Supply of and Demand for Ph.D. Scientists and Engineers, 1980, U.S.

(000)

	Low	Medium[1]	High
Demand[2]	18.6	20.8	23.0
Supply[3]	15.2	23.2	25.7
Degrees needed to meet demand[3]	20.7	23.1	25.6

1. Average of "low" and "high".

2. Annual growth plus replacement at 2.5 percent of 1980 projections shown in Table 24. Assumes that the number who leave the field will be offset by the relative youthfulness of the current Ph.D. supply.

3. Assumes that 90 percent of those receiving degrees will be available for employment in science or engineering positions.

1969-80 growth in employment of Ph. D. scientists and engineers will be strongest in mathematics and the life and social sciences.

Figure 27 -- Change in Employment Level of Ph.D. Scientists and Engineers, by Field, 1969-80, U. S.

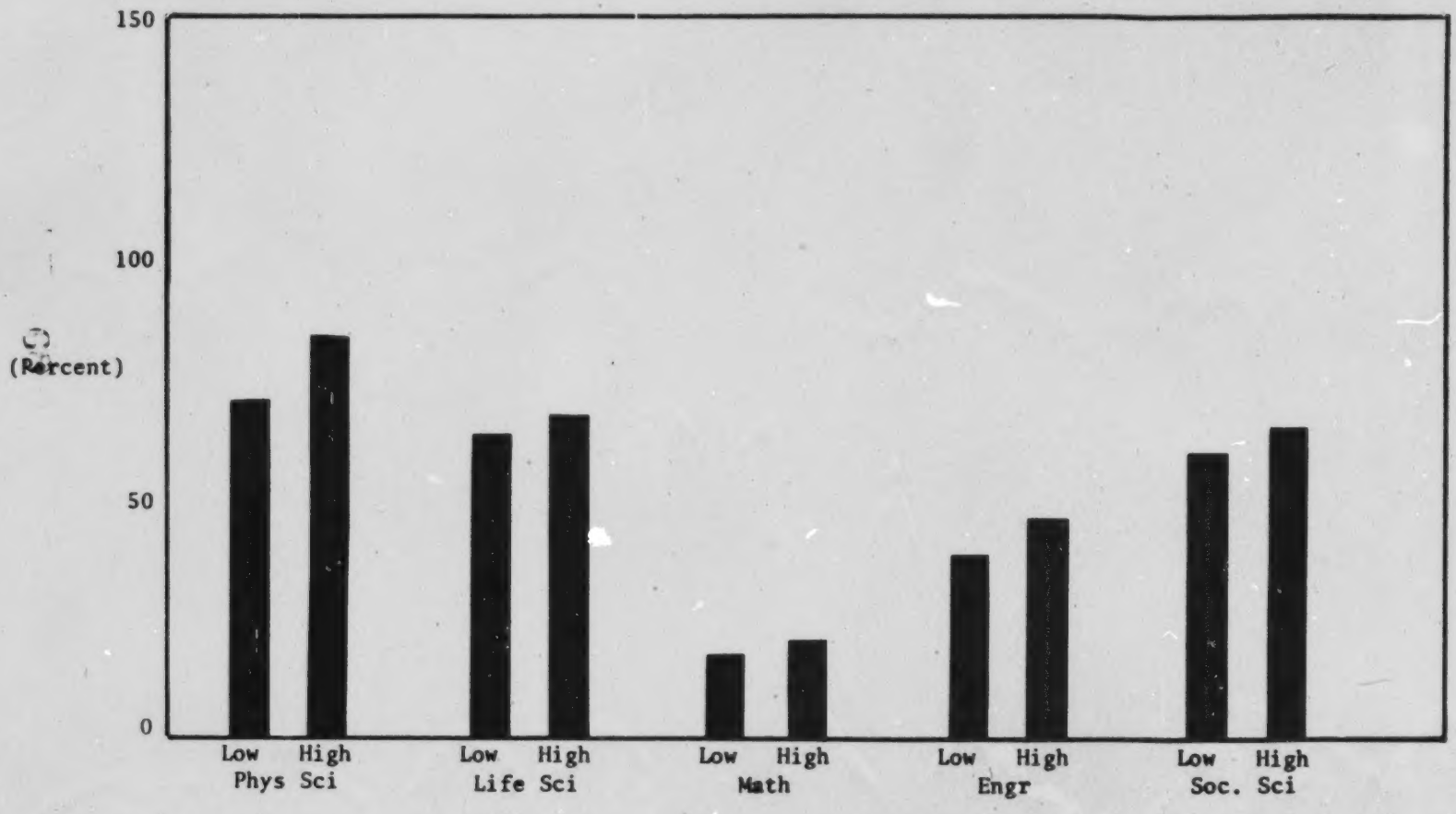

Table 27 -- Employment Level of Ph.D. Scientists and Engineers, by Field, 1969-80, U.S.

(000)

	1969	1980 (Low)		1980 (High)	
		Number	Change over 1969	Number	Change over 1969
Physical Sciences	51.4	71.0	+38.1%	83.2	+61.9%
Life Sciences	39.2	65.9	+68.1%	70.4	+75.6%
Mathematics	9.7	19.9	+104.1%	20.7	+113.4%
Engineering	22.7	34.5	+52.0%	40.0	+76.2%
Social Sciences	35.0	62.0	+77.1%	66.6	+90.3%

Source: National Science Foundation, "1969 and 1980 Science and Engineering Doctorate Supply and Utilization," NSF 71-20, May, 1971.

If graduate enrollment grows to meet demands, continuation of 1960-70 trends in the "mix" could result in shortages of Ph. D.'s in the life, physical and social sciences, and surpluses in other fields by 1980.

Figure 28 -- Supply of and Demand for Ph.D. Scientists and Engineers, by Field, 1980, U.S. (medium projection)

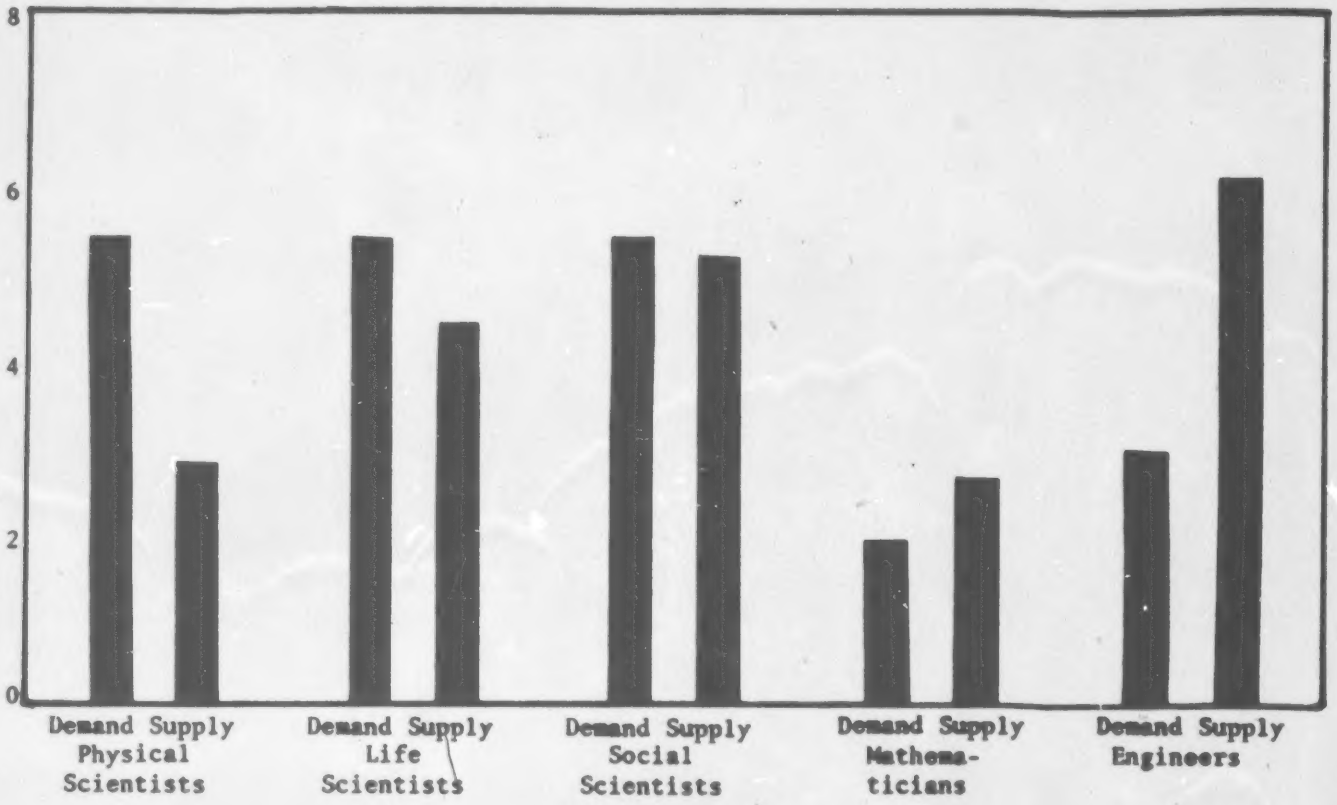

Table 28 -- Supply of and Demand for Ph.D. Scientists and Engineers, by Field, 1980, U.S.[1]

(000)

	Low	Medium[2]	High
Physical Scientists			
Demand	4.4	5.4	6.3
Supply	2.5	2.8	3.1
Life Scientists			
Demand	5.0	5.4	5.8
Supply	3.9	4.4	4.8
Social Scientists			
Demand	5.0	5.4	5.7
Supply	4.6	5.2	5.7
Mathematicians			
Demand	1.8	1.9	1.9
Supply	2.3	2.6	2.8
Engineers			
Demand	2.4	2.9	3.3
Supply	5.4	6.1	6.7

1. Demand = Growth plus replacement at 2.5 percent. Supply = 90 percent of projected degrees, based on 1960-70 trends in growth by field, applied to "degrees needed" as shown in Table 26.

2. Average of "Low" and "High".

Note: The inevitable slow-down in doctorate production through at least 1975-6 indicates that the supply figures should be higher--by an undetermined amount--from those shown in this table.

Trends in degrees awarded should be such that the greatest growth will occur in the physical and life sciences, and mathematics.

Figure 29 -- Desired Change in Doctorates Granted in Science and Engineering, by Field, (1980 compared with 1970), U. S.

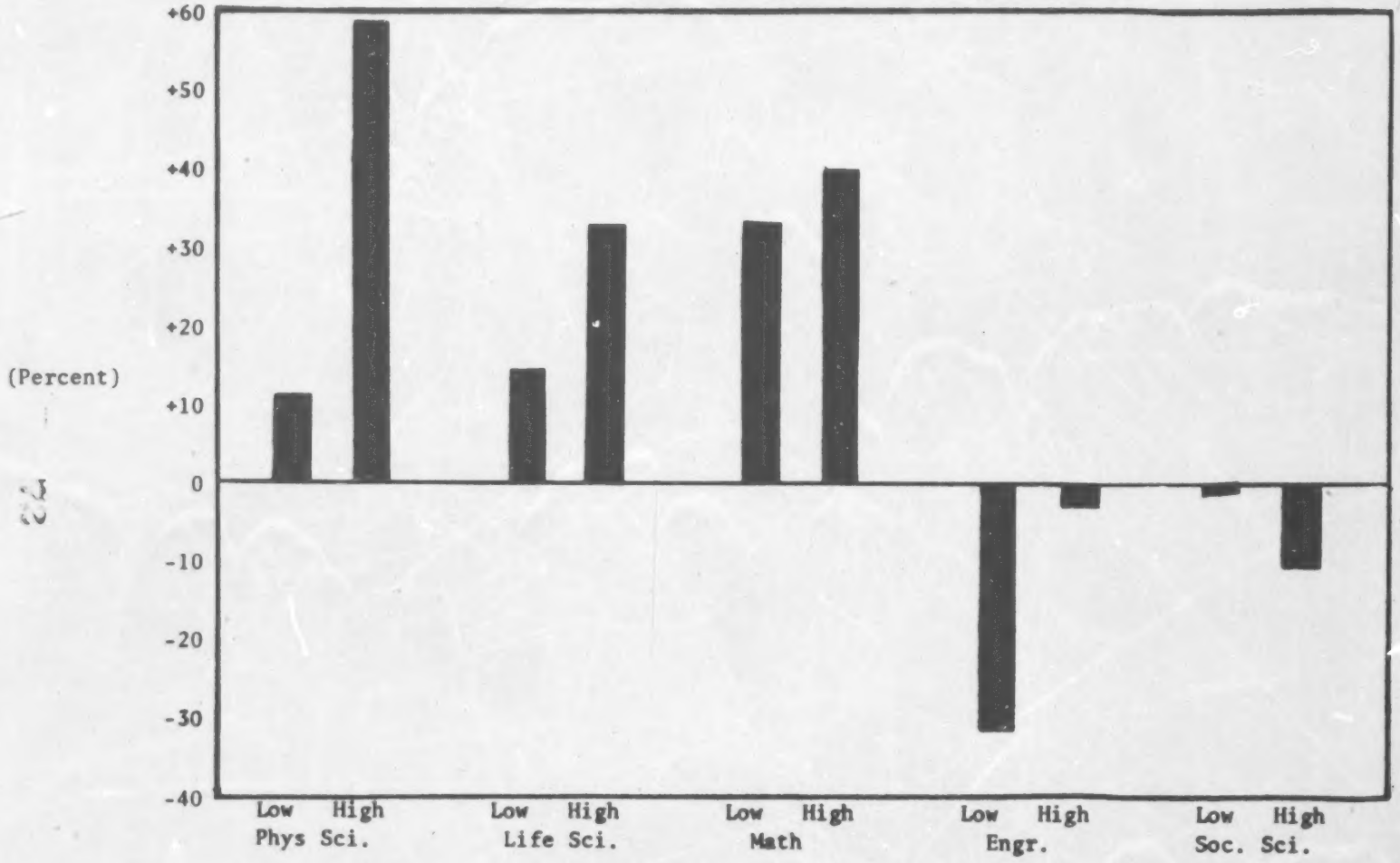

Table 29 -- Doctorates Granted in Science and Engineering, by Field, 1960, 1970 and Desired for 1980, U.S.

(000)

			1980			
			Low		High	
	1960	1970	Number	Percent Change	Number	Percent Change
Physical Sciences	2.0	4.4	4.9	+11.1	7.0	+59.0
Life Sciences	1.8	4.9	5.6	+14.3	6.5	+32.7
Mathematics	.3	1.5	2.0	+33.3	2.1	+40.0
Engineering	.9	3.8	2.6	-31.6	3.7	- 2.6
Social Sciences	2.1	5.7	5.6	- 1.8	6.3	+10.5
TOTAL	7,140	19,900	20,700	+22.7	25,600	+48.9

Note: The inevitable slow-down in doctorate production through at least 1975-6 indicates that the supply figures should be higher--by an undetermined amount-- than those shown in this table.

SECTION IV

Trends in
Agriculture and Natural Resources

United States

Number of U. S. farms has declined steadily since 1935, but enrollment and degrees in agriculture have increased at an accelerating pace.

Figure 30 -- Number of Farms and Bachelor's Degrees and Enrollment in Agriculture, U. S.

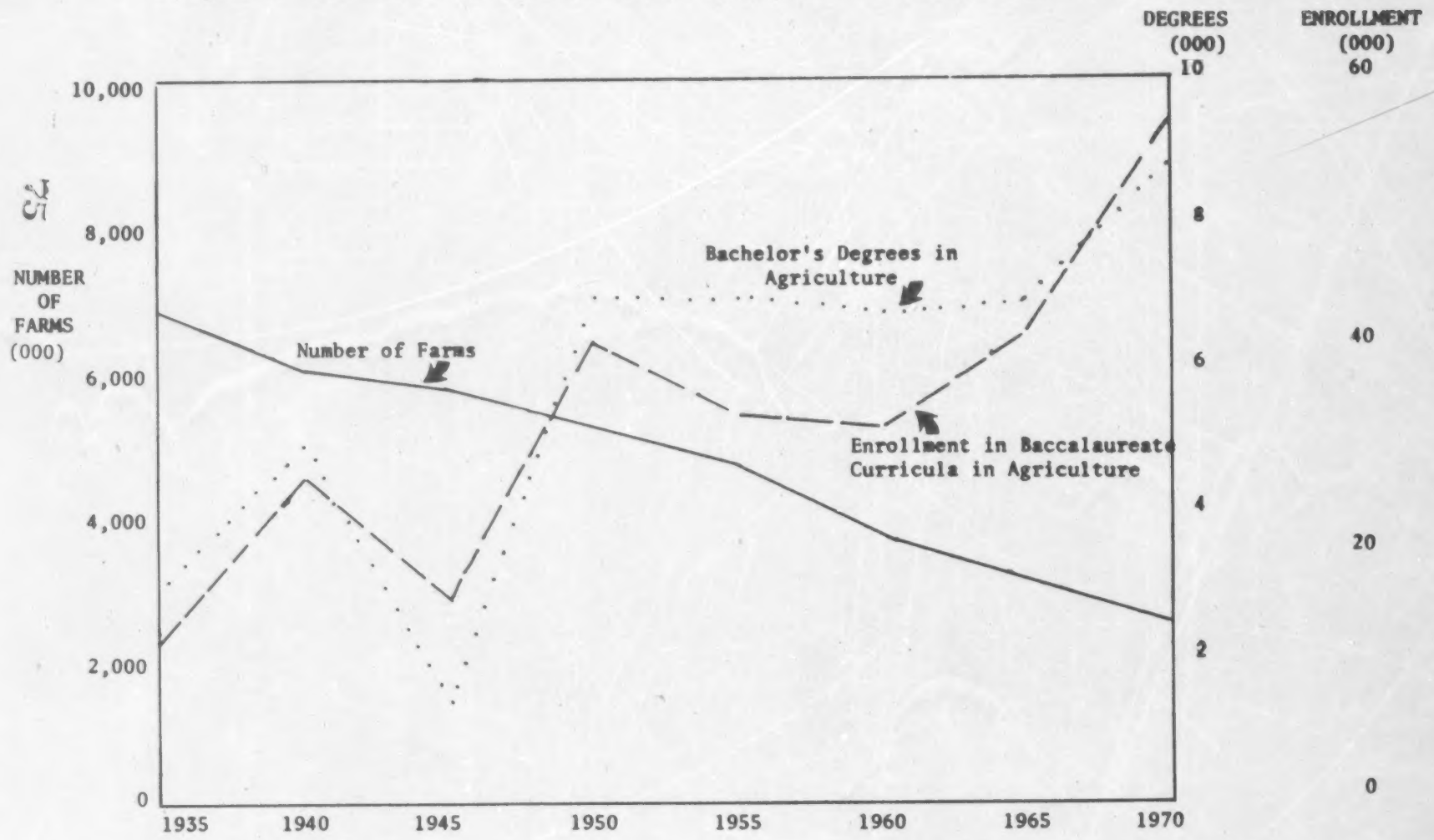

Table 30 -- Number of Farms and Bachelor's Degrees and Enrollment in Agriculture, U.S.

	1935	1940	1945	1950	1954	1959	1964	1969
Number of Farms (000)	6,812	6,097	5,859	5,382	4,782	3,704	3,153	2,585
					1955	1960	1965	1970
Bachelor's Degrees in Agriculture[1]	2,640[2]	5,065[3]	1,470[3]	7,025	7,020	6,820	6,965	8,840[4]
Enrollment in Baccalaureate Curricula in Agriculture[5]	13,000	27,005	17,320	40,535	33,510	32,620	41,325	56,130

1. 5-year average of degrees awarded by all U.S. institutions, centered on year shown, except as indicated.

2. Excludes 1934-5, for which data were not available.

3. Estimated, based on trends in forestry degrees. Data not available.

4. Excludes 1971-2, for which data were not available.

5. Five-year average of enrollment in Land-Grant Colleges, centered on year indicated.

Sources: USDA: U.S. Office of Education; Society of American Foresters; Enrollment Survey by L.M. Thompson, Iowa State University.

The infusion of educated manpower has played a major role in the doubling of farm output and efficiency during the past four decades.

Figure 31 -- U. S. Farm Output & Efficiency

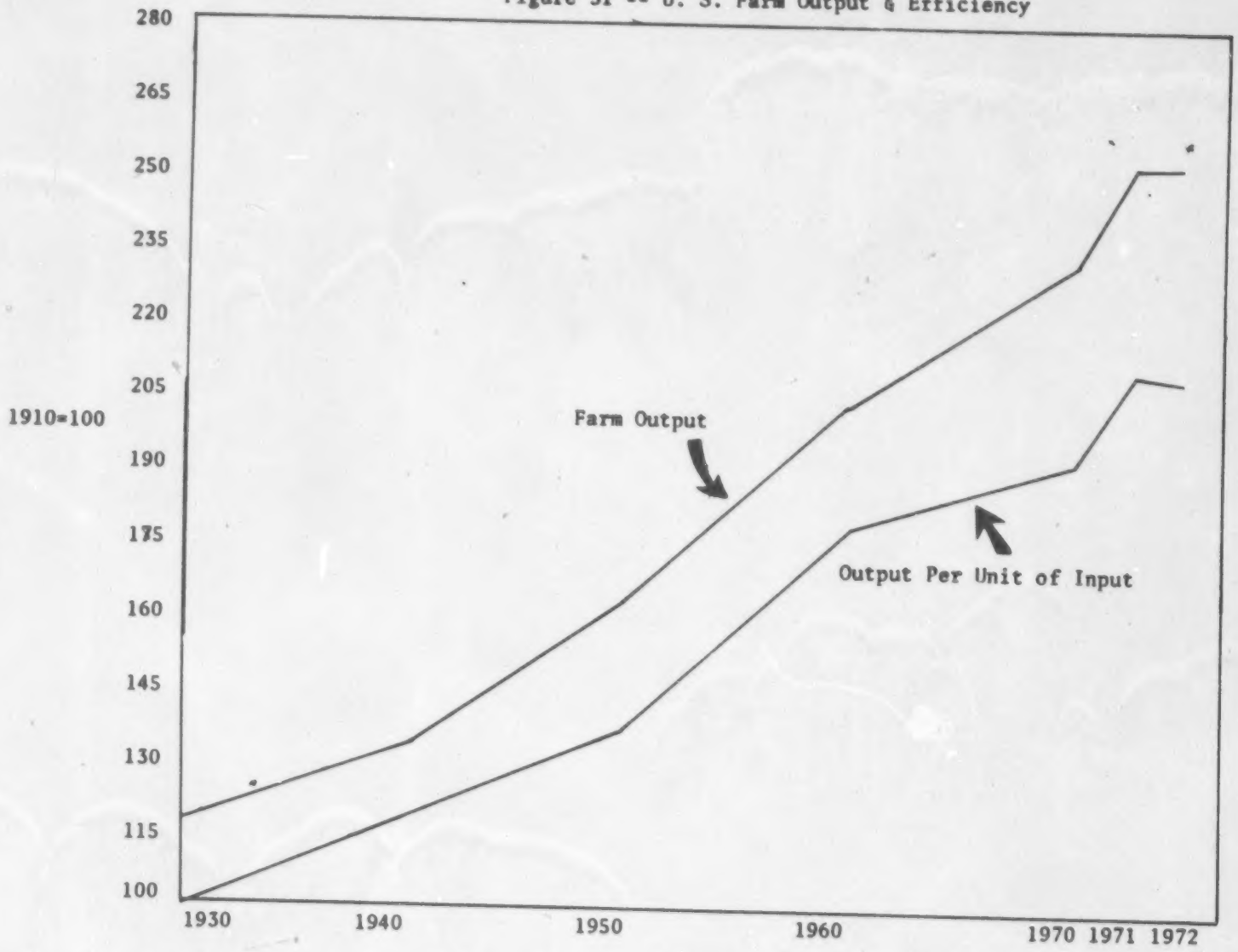

Table 31 -- Farm Output and Efficiency, U.S.

(1910 = 100)

	1930	1940	1950	1960	1970	1971	1972
Farm Output	118	13	165	204	231	251	251
Production Inputs	118	115	119	114	120	120	121
Output per Unit of Input	100	117	139	178	192	209	207

Source: U.S. Department of Agriculture.

Population growth combined with export demand will require a one-third increase in farm output between 1970 and 1985.

Figure 32 -- Population, Exports and Farm Output

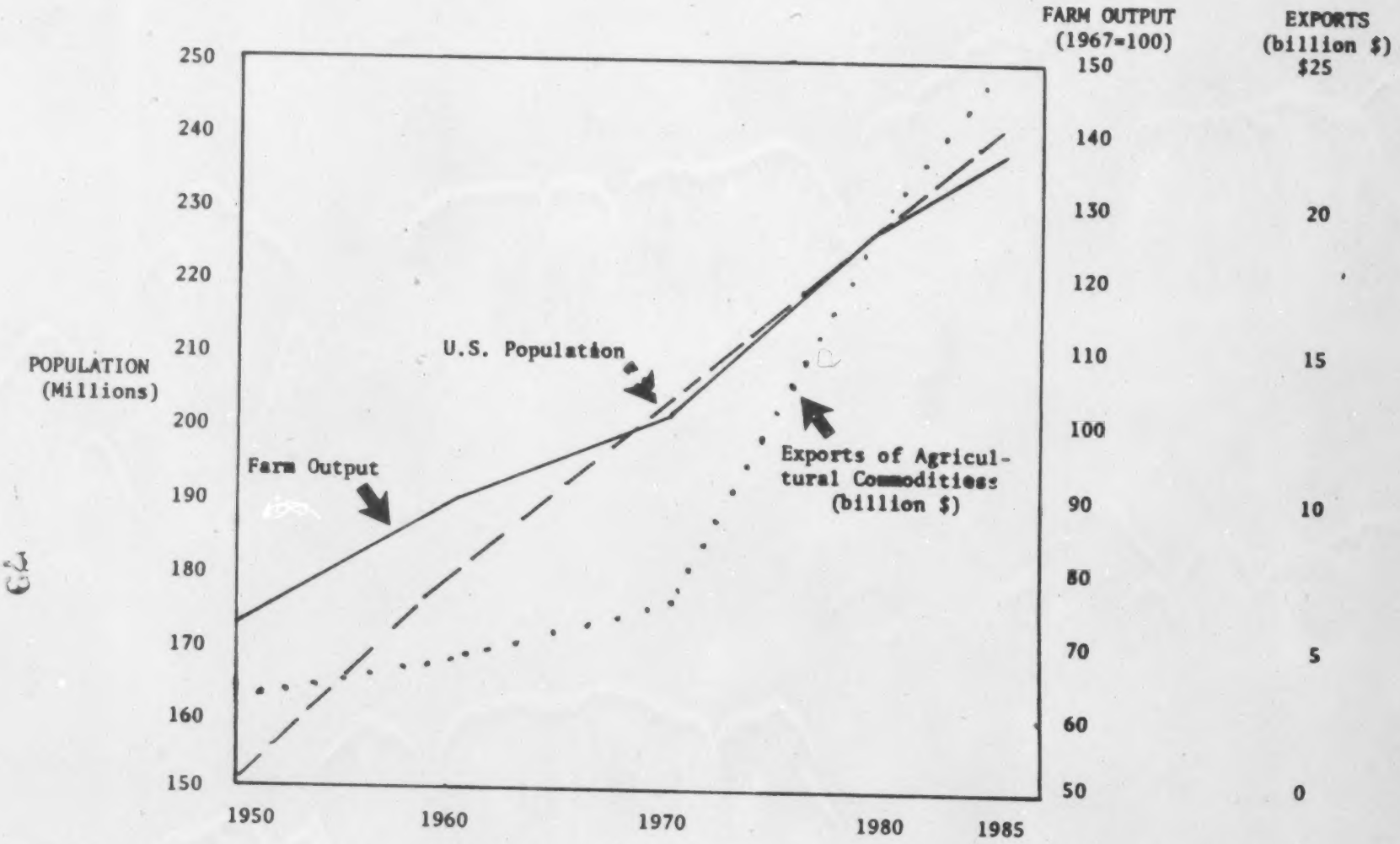

Table 32 -- U. S. Population, Agricultural Exports and Farm Output

	1950	1960	1970	1980	1985
U. S. Population (millions)	152	180	204	227.5[1]	241[1]
Exports of Agricultural Commodities (billion $)	$3.0	$4.5	$6.7	$20.0[2]	$25.0[2]
Farm Output (1967 = 100)	73	90	102	126.5[3]	137[3]

1. Source: U. S. Bureau of the Census, Series D.

2. Based on 1970-3 trend (increase from $6.7 to $11 billion) and USDA projection of reaching $15 billion before 1980.

3. Source: Scofield, W. H., Economic Research Service, USDA, personal communication.

Other sources: USDA, "Agricultural Statistics," 1972.

However, cropland acreage cannot be increased substantially without reducing acreage needed for pasture, forests, recreation, wildlife habitat, soil conservation and urban use.

Figure 33 -- Land Use by Category

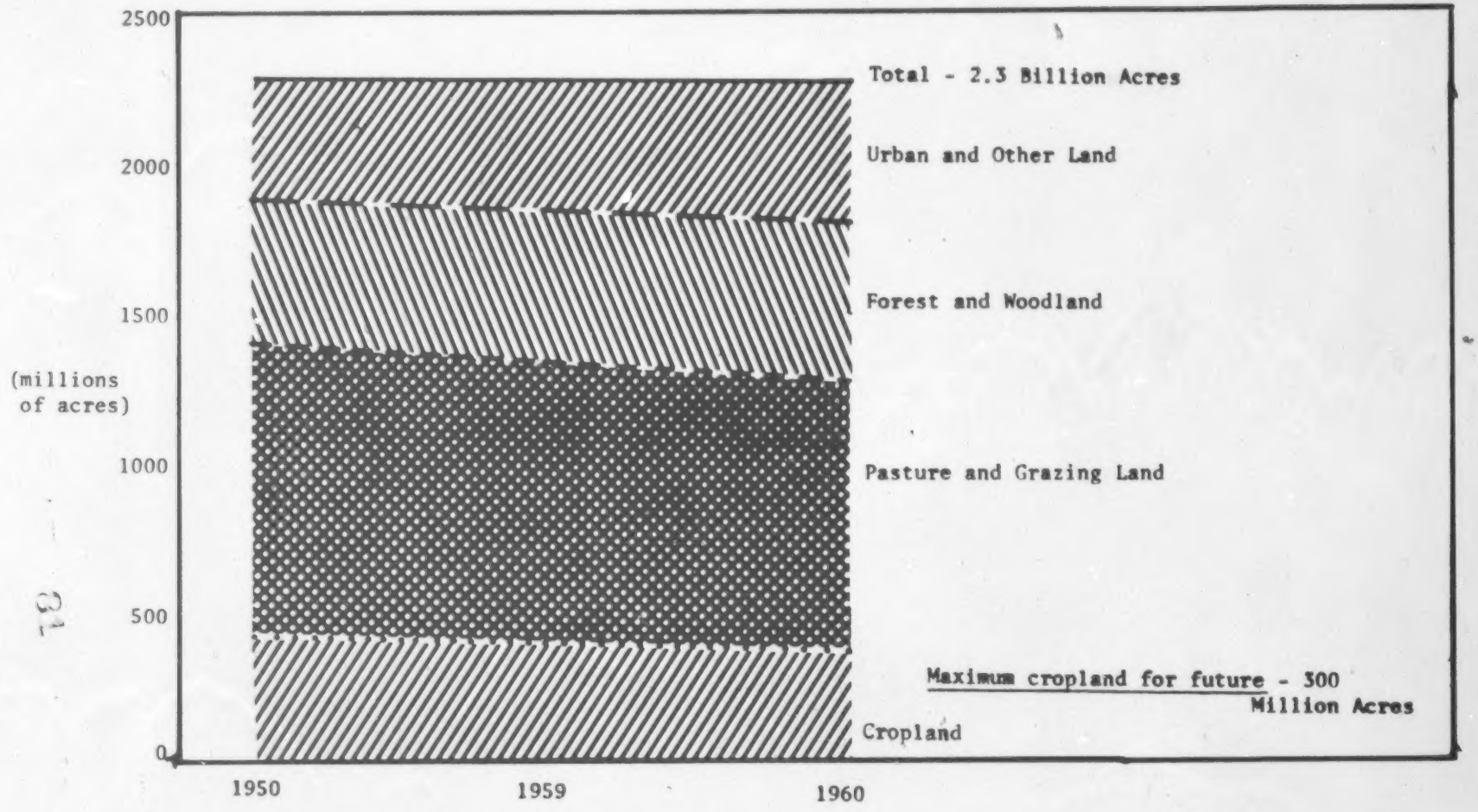

Table 33 -- Land Use in the United States

(Millions of Acres)

	1950	1959	1969	Future
Cropland Used for Crops or Idle	409	392	387	300[1]
Pasture and Grazing Land	1,023	944	889	
Forest and Woodland	454	508	526	
Other Land[2]	387	427	462	
	2,273	2,271	2,264	

1. Assumes that cropland which is unsuitable or marginal for crop production (75 million acres) will be taken out of production and that additional cropland will be lost to urban uses, over and above new land brought into production.

2. Includes urban areas, parks and wildlife refuges, etc.

Source of historic data: U. S. Department of Agriculture.

It is imperative that progress in agricultural efficiency continue and even accelerate. This will require college-educated manpower for positions in research and education, as well as in supplying services and purchased inputs for farming.

Figure 34 -- Crop and Livestock Efficiency, and Inputs Purchased by U. S. Farmers

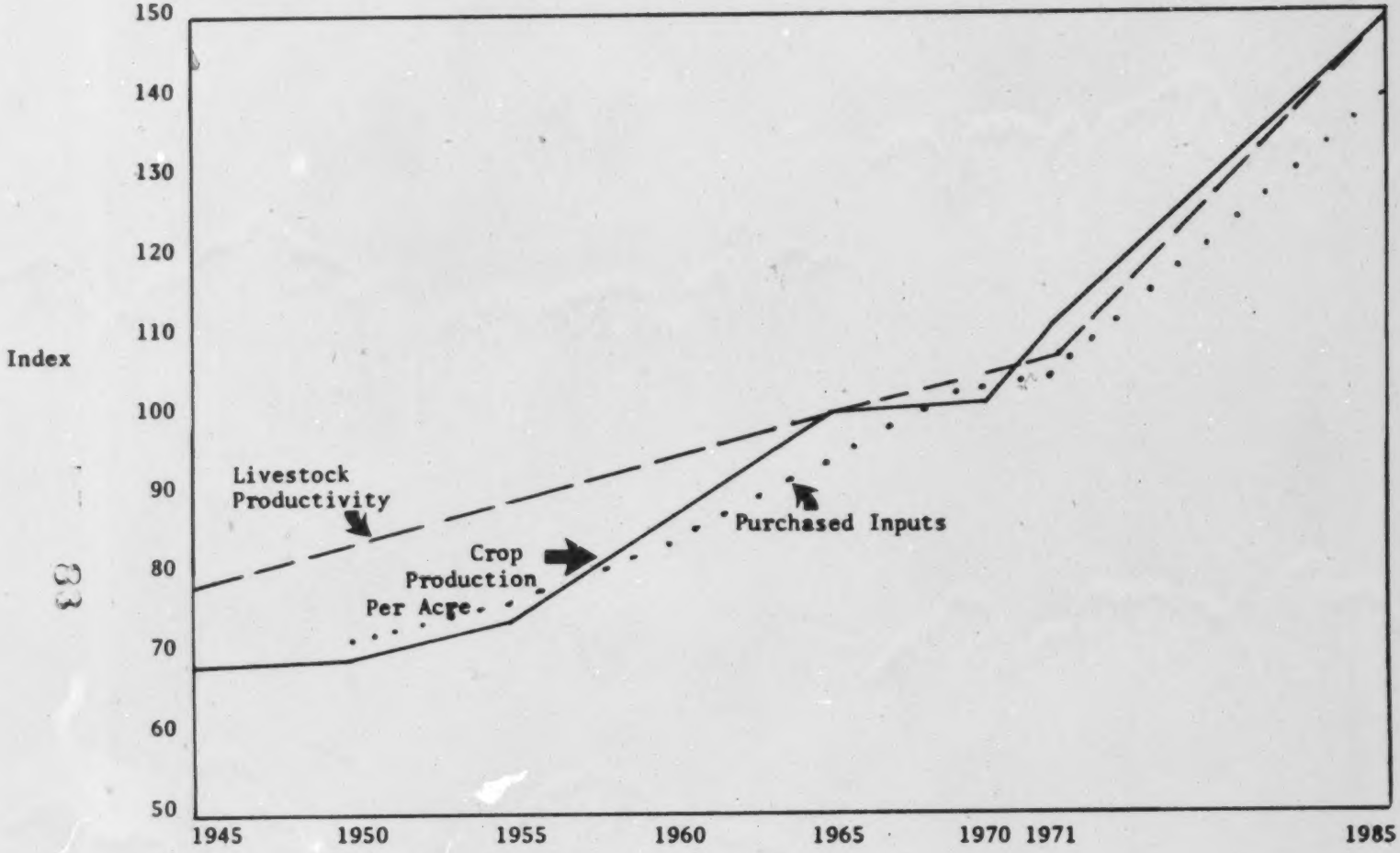

Table 34 -- Crop and Livestock Efficiency, and Inputs Purchased by U.S. Farmers

	1945	1950	1955	1960	1965	1970	1971	1985
Crop Production per Acre[1] (1967 = 100)	68	69	74	88	100	102	111	150[2]
Livestock Productivity[3] (1965 = 100)	78	84	90	94	100	105	107	150[2]
Purchased Inputs[4] (1967 = 100)	NA	71	76	84	94	104	105	140[5]

1. Source: USDA, "Changes in Farm Production and Efficiency," June, 1972.

2. Based on projected output requirements, and projected decline in cropland as shown in Table 33.

3. Ratio of output of livestock and products to the number of animal units fed. Source of historic data: USDA, "Agricultural Statistics," 1972.

4. Farm machinery, fertilizer, pesticides, etc. Source: USDA, "Changes in Farm Production and Efficiency," June, 1972.

5. Source: Scofield, W.H., Economic Research Service, USDA, personal communication.

Rising demand for timber products will require an increase in domestic production of 50 to 100 percent by the year 2000.

Figure 35 -- Production of Timber Products for Industrial Use, U. S.

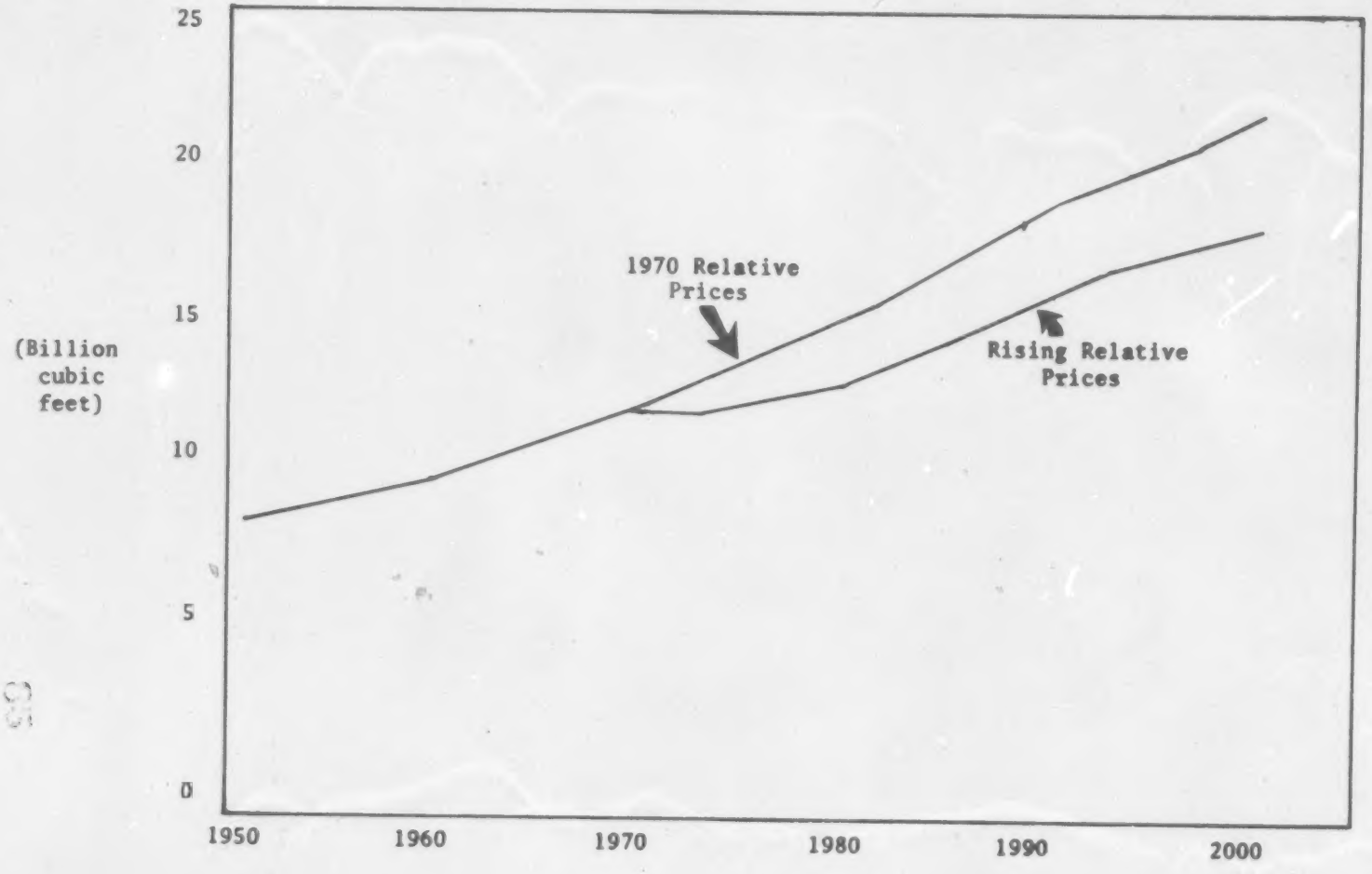

Table 35 -- Production of Timber Products for Industrial Use, U.S.

(Million Cubic Feet, Roundwood Equivalent)

	1950	1960	1970	1980	1990	2000
Projected--1970 Relative Prices	--	--	--	15.5	18.7	21.8
Actual	8.5	8.9	11.0	--	--	--
Projected--Rising Relative Prices[1]	--	--	--	13.6	14.6	16.1

1. Relative prices rising from 1970 trend levels as follows: lumber--1.5 percent per year; plywood and miscellaneous products--1.0 percent per year; paper and board--0.5 percent per year.

Source: USDA, "The Outlook for Timber in the United States," Review Draft, U.S. Forest Service, December 5, 1972.

Supply of hardwood timber will be adequate to meet demand without increases in relative prices.

Figure 36 -- U. S. Hardwood Timber Supply-Demand Relationships

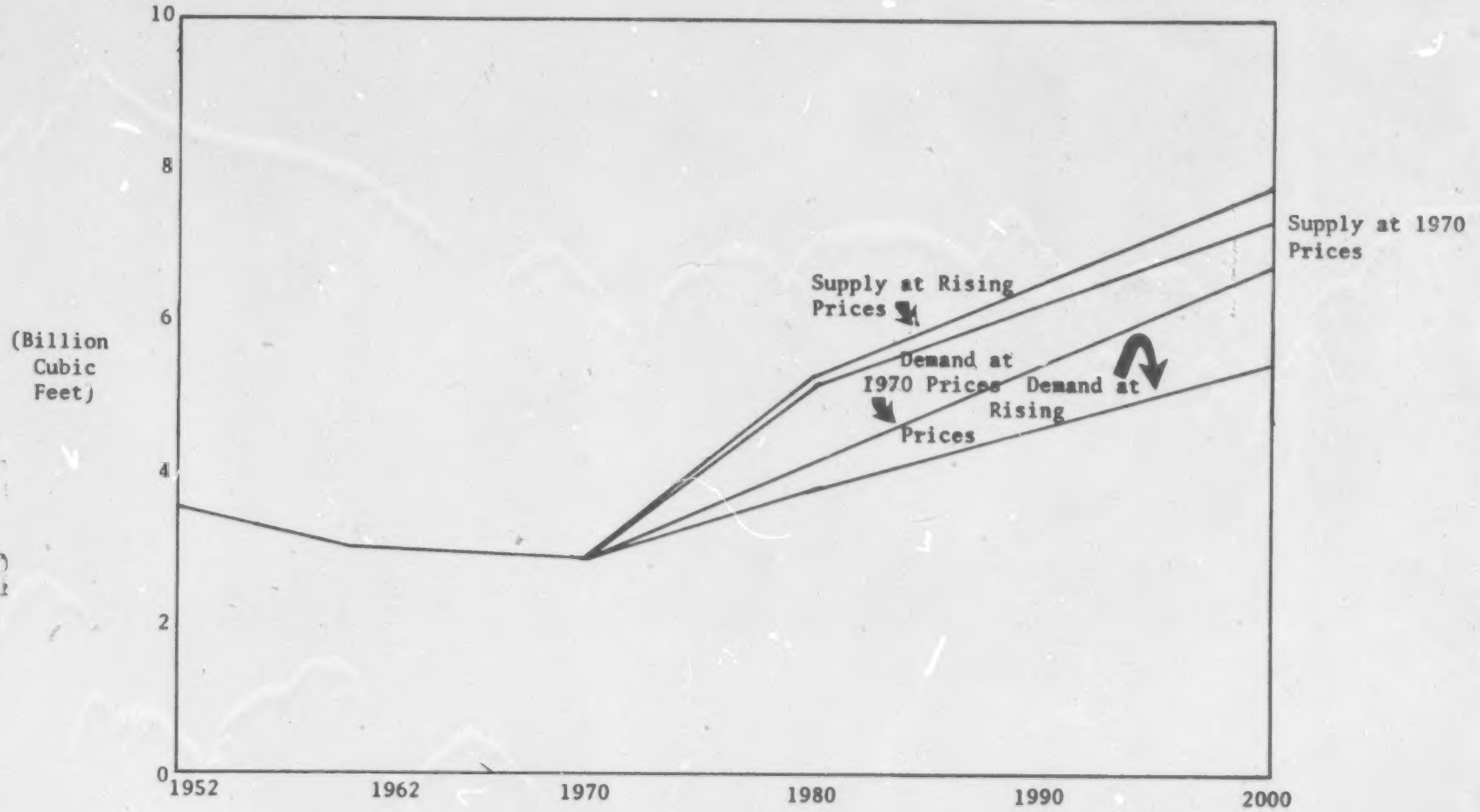

Table 36 -- U.S. Hardwood Timber Supply-Demand Relationships[1]

(Billion Cubic Feet)

				1970 Relative Prices			Rising Relative Prices[2]		
	1952	1962	1970	1980	1990	2000	1980	1990	2000
Demand on U.S. Forests	3.5	3.0	2.9	4.2	5.4	6.8	3.8	4.6	5.5
Supply from U.S. Forests (1970 Management Levels)	3.5	3.0	2.9	5.2	6.3	7.4	5.3	6.5	7.8
Supply-Demand Balance	-	-	-	+1.0	+ .9	+ .6	+1.5	+1.9	+2.3

1. Hardwood is used primarily in the form of lumber, plywood, veneer and pulp, for housing and other construction, railroads, furniture, etc.

2. Lumber - 1.5 percent per year; plywood, miscellaneous products and fuelwood - 1.0 percent per year; paper and board - .5 percent per year.

Source: USDA, "The Outlook for Timber in the United States," Review Draft, U.S. Forest Service, December 5, 1972.

Supply of the preferred softwoods at current management levels will not meet demand unless prices rise relative to the general price level.

Figure 37 -- U. S. Softwood Timber Supply-Demand Relationships

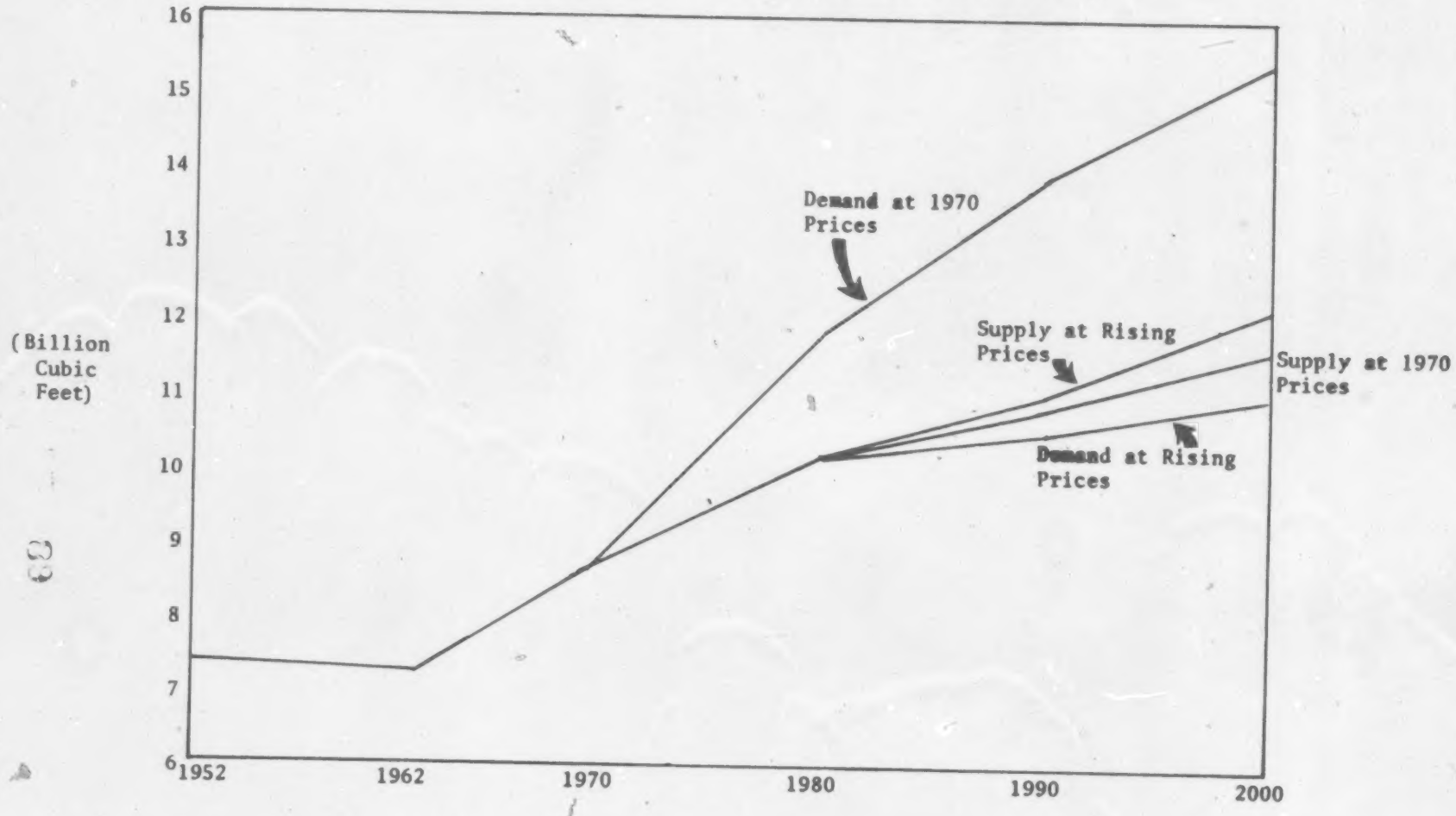

Table 37 -- U.S. Softwood Timber Supply-Demand Relationships[1]

(Billion Cubic Feet)

				1970 Relative Prices			Rising Relative Prices[2]		
	1952	1962	1970	1980	1990	2000	1980	1990	2000
Demand on U. S. Forests	7.3	7.2	8.7	11.8	13.9	15.5	10.2	10.5	11.0
Supply from U. S. Forests (1970 Management Levels)	7.3	7.2	8.7	10.1	10.8	11.6	10.1	11.0	12.2
Supply-Demand Balances	-	-	-	-1.7	-3.1	-3.9	- .1	+ .5	+1.2

1. Softwood consumption in the U. S. is approximately three times that of hardwood; softwood is used in the form of lumber, plywood, veneer and pulp, for housing and other construction, paper, etc.

2. Lumber - 1.5 percent per year; plywood, miscellaneous products and fuelwood - 1.0 percent per year; paper and board - .5 percent per year.

Source: USDA, "The Outlook for Timber in the United States," Review Draft, U. S. Forest Service, December 5, 1972.

Due to growing urban pressures, the greater volume of forest products needed in the future will have to be produced on less forest land.

Figure 38 -- Commercial Forest Land, U. S.

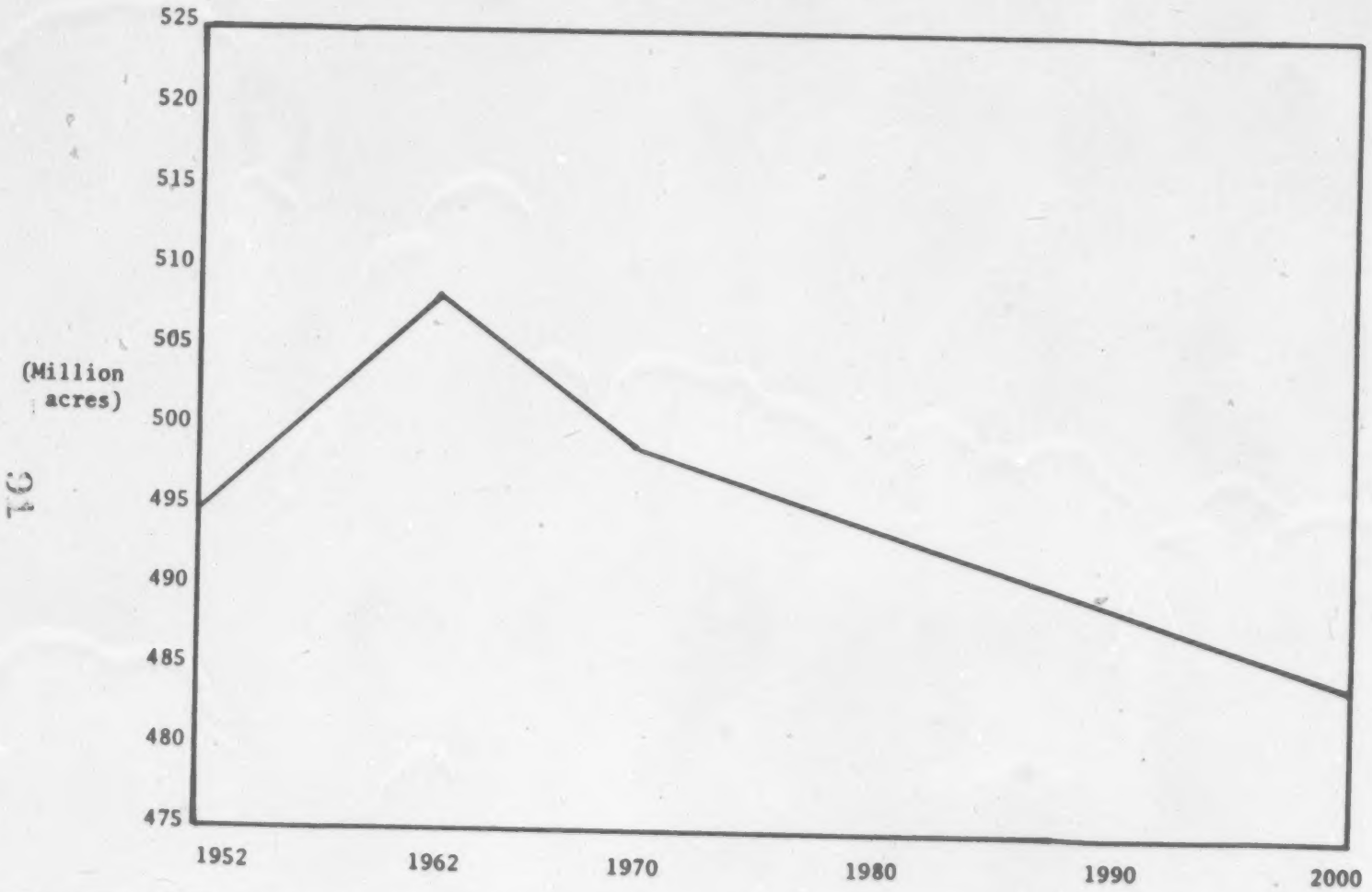

Table 38 -- Commercial Forest Land, U.S.

(Million Acres)

1952	1962	1970	1980	1990	2000
495.0	508.4	499.7	494.7	489.7	484.7

Source: USDA, "Outlook for Meeting Future Timber Demands," U.S. Forest Service, Current Information Report No. 8, December, 1972.

Multiple use of forest land -- for recreation, wildlife habitat and other uses in addition to timber production -- has grown rapidly and will require an even greater application of intelligent management in the future.

Figure 39 -- U. S. National Forest Recreation Visits

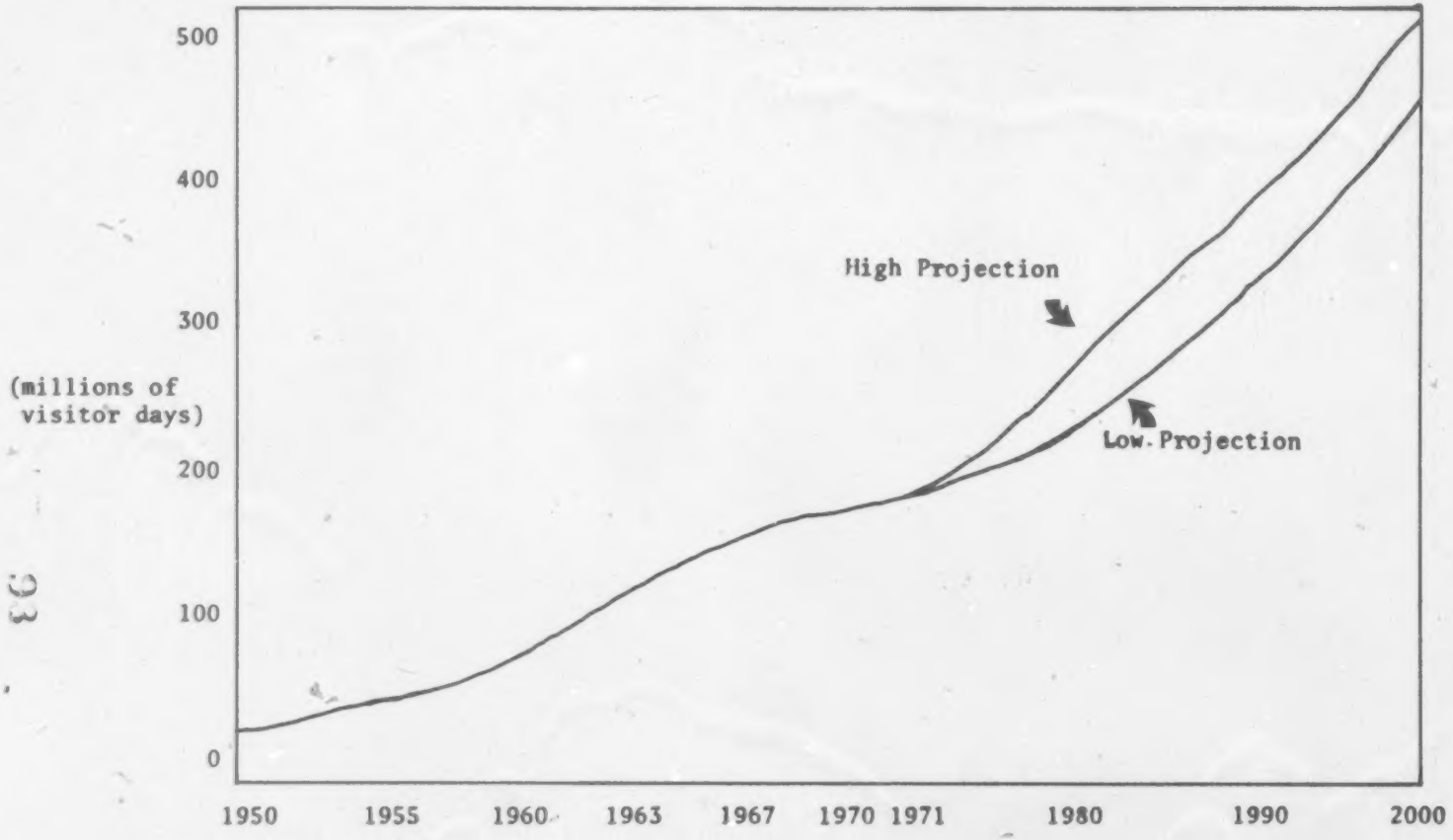

Table 39 -- U.S. National Forest Recreation Use

(Millions of Visitor Days)

	1950	1955	1960	1963	1967	1970	1971		1980	1990	2000
Actual Visits	27.4	45.7	92.6	122.6	149.6	172.6	178.1		--	--	--
Per Capita	.18	.28	.51	.65	.76	.84	.86	(Low)	1.10	1.35	1.60
								(High)	1.17	1.50	1.83
Projected											
Low[1]	--	--	--	--	--	--	--		250.3	343.8	449.1
High[2]	--	--	--	--	--	--	--		266.2	382.0	513.7

1. Based on low per capita trend, which is projected on the 1967-71 trend.

2. Based on high per capita trend, which is projected on the 1960-71 trend.

Source of historic data: Statistical Abstract.

Recreation use in local, state and national parks has doubled during each of the past two decades, and will continue to grow rapidly.

Figure 40 -- U. S. Outdoor Recreation Indicators

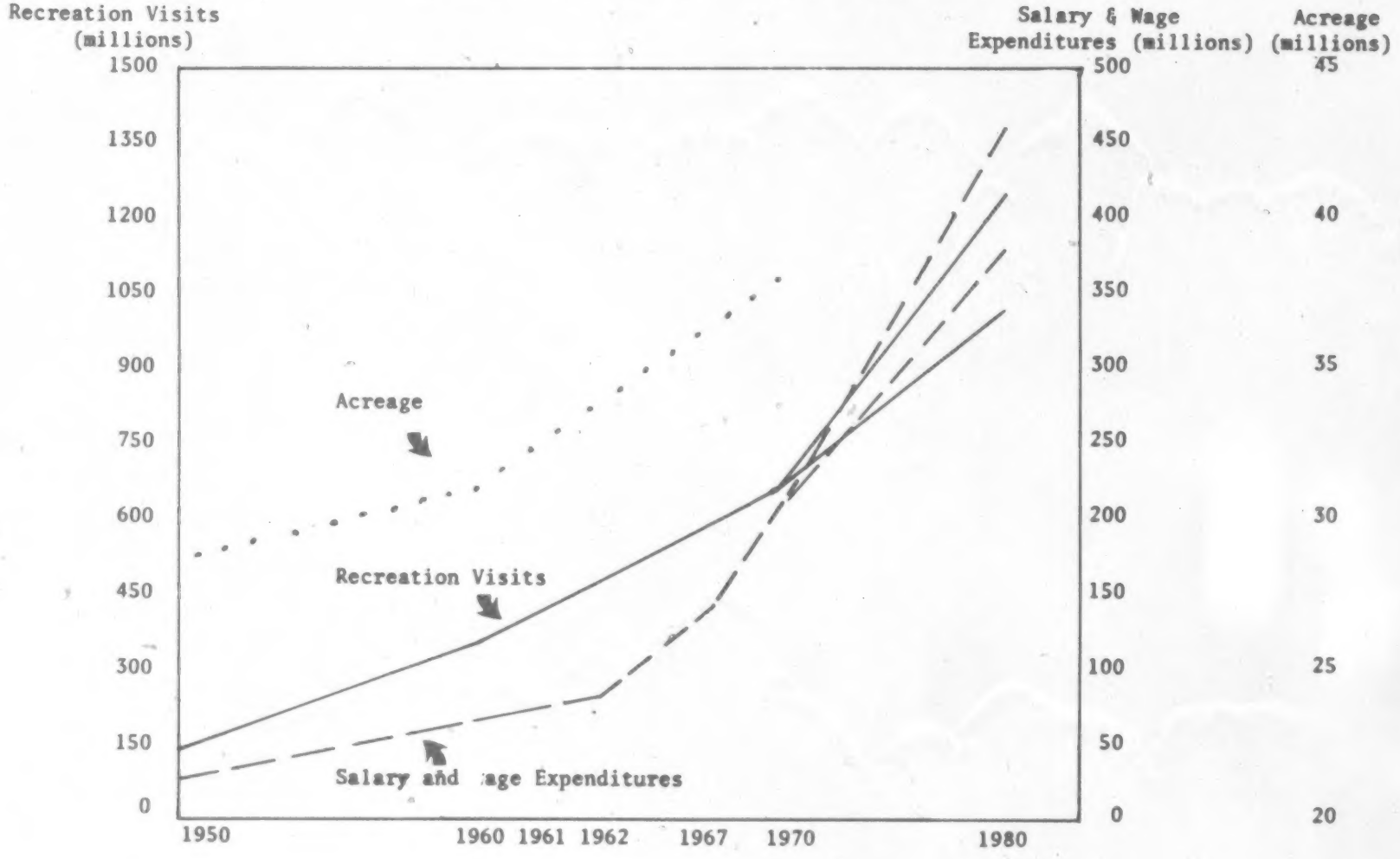

Table 40 -- Parks and Outdoor Recreation Data, U.S.

	1950	1960	1961	1962	1967	1970	1980
Acreage (000)							
Municipal and County Parks	644	1,015				966	
State Parks	4,657	5,602				8,555	
National Parks	22,976	24,458				29,630	
Total	28,277	31,075				38,151	
Recreation Visits (millions)							
State Parks	114.3	259.0				482.5	
National Parks	33.3	79.2				172.0	
Total	147.6	338.2				654.5	1024 - 1244.8
Percent Increase	--	129%				93.5%	56%-90%
Per Capita (U.S. Population)	.97	1.88				3.21	4.50-5.48
Salary and Wage Expenditures (millions)							
State Parks	$13.6	$37.1	$41.1	$42.7	$77.1	$121.5	
National Parks	11.8	29.9	34.3	37.0	62.1	82.5	
Total	$25.4	$67.0	$75.4	$79.7	$139.2	$204.0	$377.7 - $455.0
Percent Increase		164%				204.5%	85%-122%
Per Capita (U.S. Population)	$ .17	$ .34	$ .41	$ .43	$ .70	$ 1.00	$1.66 - $2.00

Source of historic data: Statistical Abstract.

SECTION V

Professional Manpower in Agriculture and Natural Resources

United States

Employment of professional manpower in agriculture and natural resources in the United States rose 49 percent from 1960 to 1970 and will increase 48 percent by 1980.

Figure 41 -- Professional Manpower in Agriculture and Natural Resources, U. S.

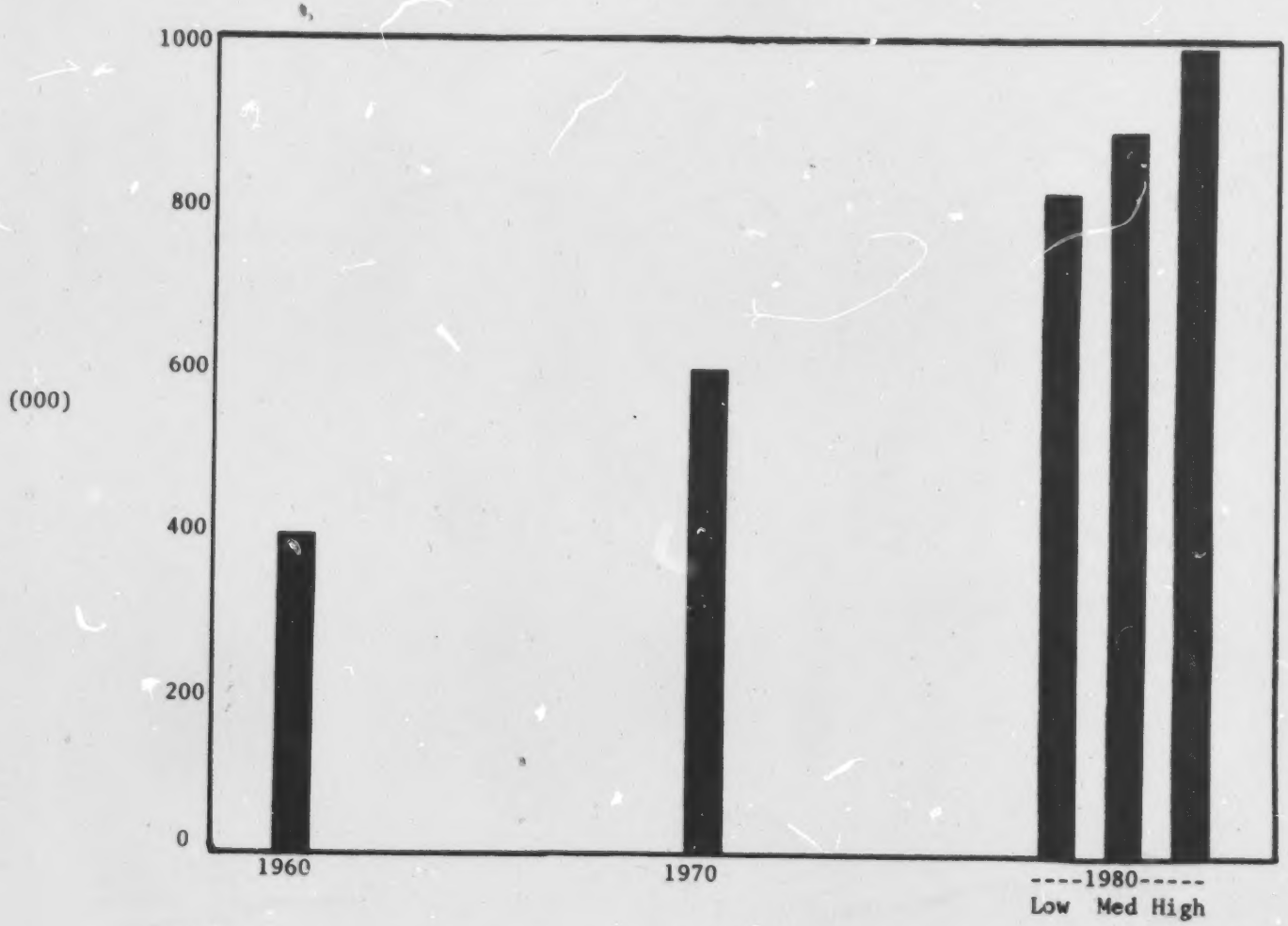

Table 41 -- Professional Manpower in Agriculture and Natural Resources, U.S.

By Professional Category

	1960	1970	1980 Low	1980 Medium	1980 High
Management, Sales and Related Occupations in Agribusiness (Table 46)	153,500	233,465	350,200	355,100	362,530
Agricultural Scientists (Table 48)	36,470	58,605	71,945	79,940	87,935
Agricultural Engineers (Table 49)	12,000	13,000	14,500	16,000	17,725
Vocational Agriculture Teachers (Table 50)	10,500	10,520	11,665	11,975	14,080
Teachers in Two-Year Agriculture & Natural Resource Technician Programs (Table 51)	100	1,060	2,665	2,790	2,880
Production Agriculture (Rural Farm Males with 4 Years or More of College. Table 52)	94,400	134,600	167,000	191,600	247,800
Veterinarians and Veterinary Scientists (Table 53)	17,145	25,100	36,745	40,800	44,880
Foresters (Table 54)	17,225	25,000	32,000	36,275	37,000
Parks and Outdoor Recreation Specialists (Table 55)	12,955	27,630	43,100	46,970	58,900
Fisheries Professionals (Table 56)	2,700	5,275	7,965	8,800	9,500

	1960	1970	1980 Low	1980 Medium	1980 High
Wildlife Professionals (Table 57)	6,895	7,980	7,980	9,235	10,615
Pollution Control Professionals (Table 58)	4,145	8,065	11,060	16,460	18,100
Landscape Architects (Table 59)	2,585	5,175	7,435	9,700	10,350
Laboratory Animal Management Professionals (Table 60)	560	790	1,440	1,600	1,760
Other Professional Manpower in Government Agencies[1] (Table 61)	9,035	10,940	11,480	12,755	14,030
All Other Professional Manpower[2]	19,000	28,350	38,850	42,000	46,900
TOTAL	399,215	595,555	815,790	882,000	984,985
Increase	--	+49.2%	+37.0%	+48.1%	+65.4%

1. Excludes those included in above-listed categories.

2. Resource development, conservation education, international agencies, private nonprofit organizations, etc. Five percent of all other categories.

By 1980, about 50 percent of all professional manpower in agriculture and natural resources will be employed in business and industry. Nearly one-fourth will be employed in the production phase. The remaining one-fourth will be found in government agencies, educational institutions and other employment.

Figure 42 -- Professional Manpower in Agriculture and Natural Resources, By Employment Category, U. S.

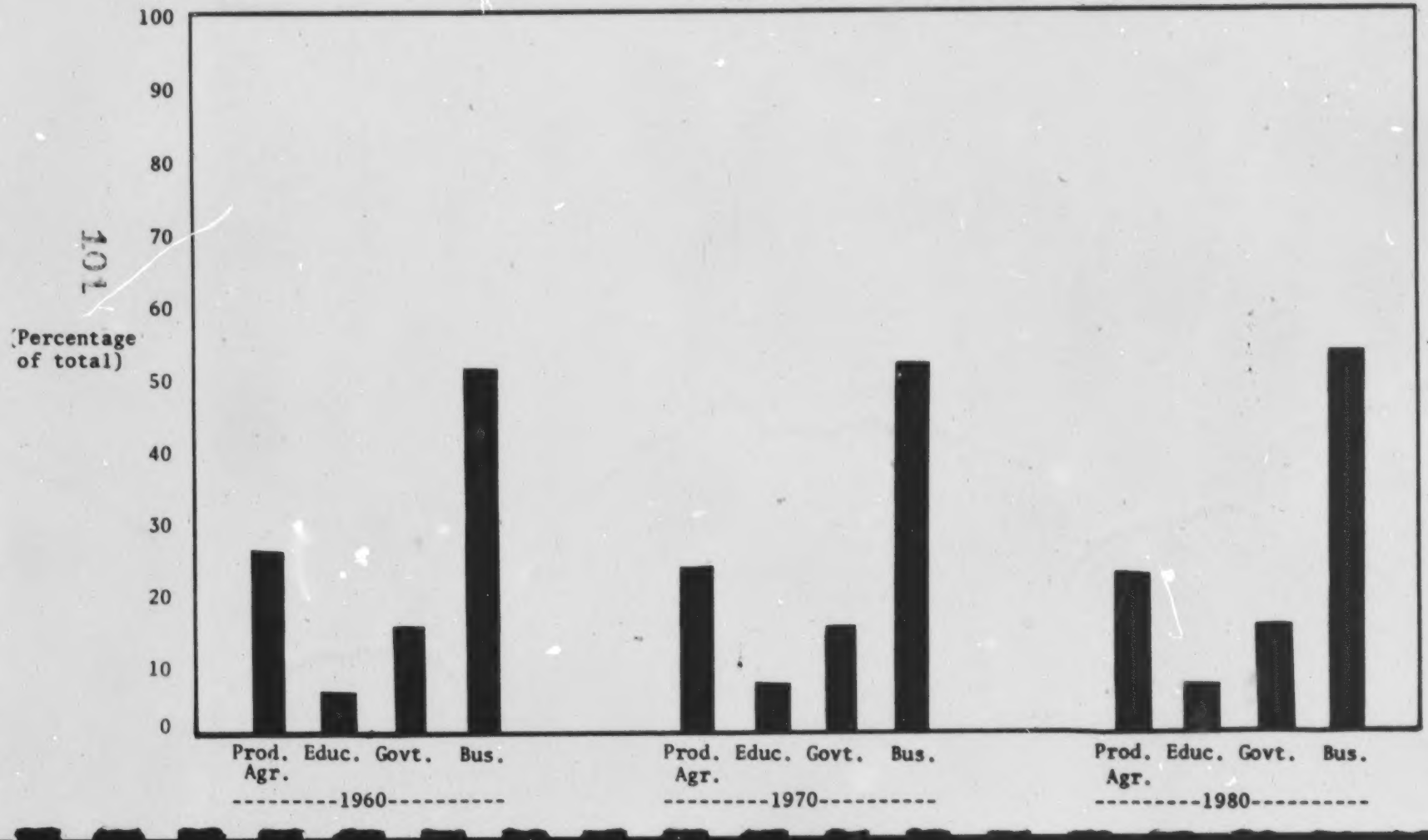

Table 42 -- Agriculture and Natural Resources Professional Employment by Employment Category, U.S.

	1960		1970		1980[1]	
	Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Production Agriculture (Rural Farm Males with 4 Years or More of College)	94,400	24.8	134,600	23.7	191,600	22.8
Educational Institutions	22,695	6.0	39,910	7.0	54,900	6.5
Government Agencies	58,270	15.3	83,990	14.2	122,780	14.6
Business and Industry	192,685	50.7	290,730	51.3	440,970	52.5
Veterinarians in Private Practice	12,165	3.2	17,975	3.2	29,750	3.6
TOTAL[2]	380,215	100.0	567,205	100.0	840,000	100.0

1. Medium projection.

2. Excludes "all other professional manpower category" in Table 41.

In 1980, as in the past, most of the agriculture and natural resources professionals who are employed in educational institutions will be agricultural scientists and teachers of vocational agriculture

Figure 43 -- Agriculture and Natural Resources Professional Employment in Educational Institutions, by Category, U. S., 1980

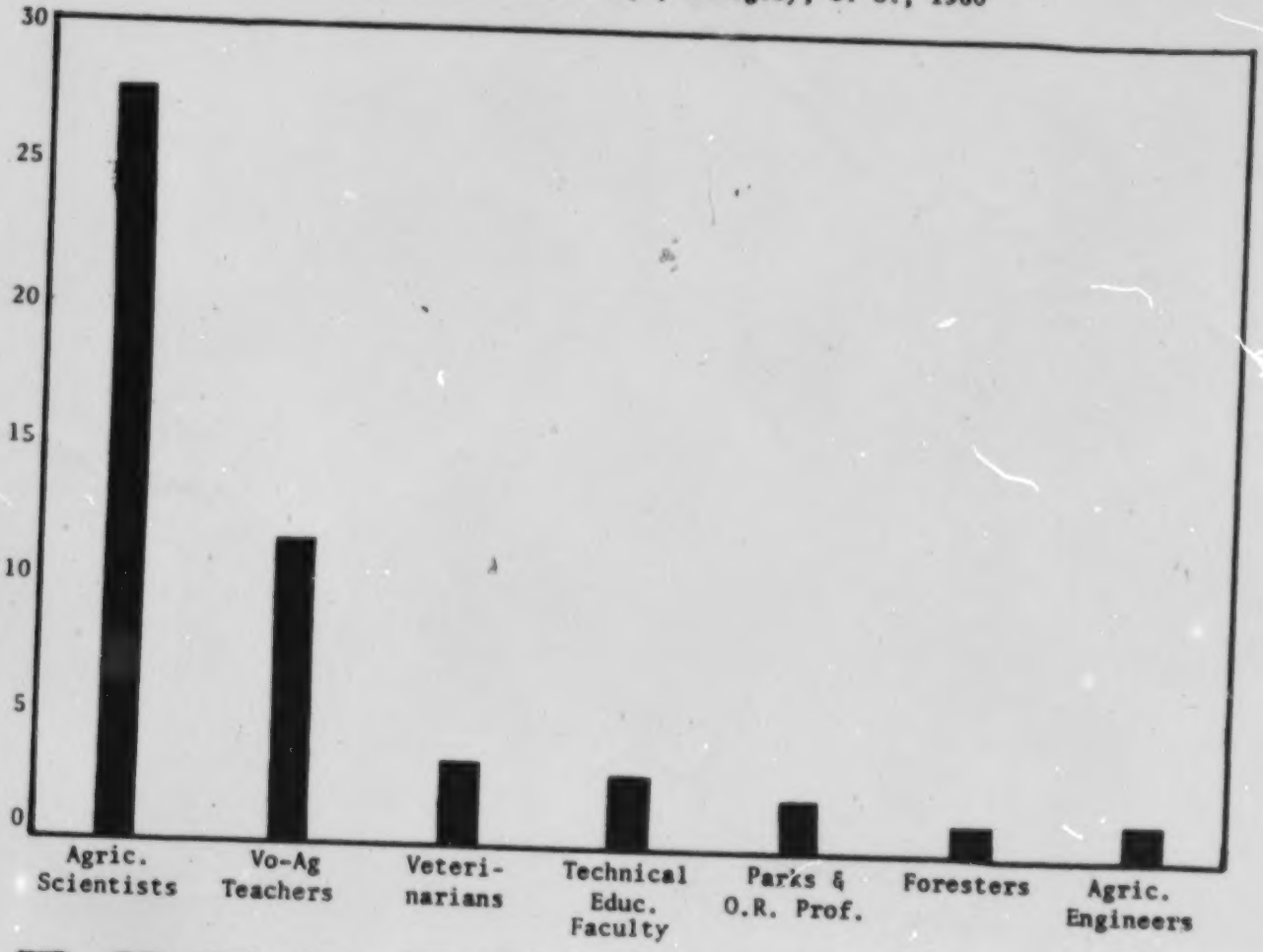

Table 43 -- Agriculture and Natural Resources Professional Employment in Educational Institutions, by Category, U.S.

	1960	1970	1980
Agricultural Scientists	6,665	21,210	28,930
Agricultural Engineers	1,125	1,220	1,505
Teachers of Vocational Agriculture	10,500	10,520	11,975
Faculty in Two-Year Technical Programs	100	1,060	2,790
Veterinarians and Veterinary Scientists	1,140	1,610	3,200
Foresters	1,105	1,155	1,385
Parks and Outdoor Recreation Professionals	830	1,265	2,150
Fisheries Professionals	305	600	1,005
Wildlife Biologists and Managers	560	650	750
Landscape Architects	180	360	680
Laboratory Animal Management Professionals	185	260	530
TOTAL	22,695	39,910	54,900

- The largest number of agriculture and natural resources professionals employed by government agencies will continue to be those in parks and recreation, followed by agricultural scientists and foresters.

Figure 44 -- Professional Employment in Government Agencies, By Category, U. S., 1980

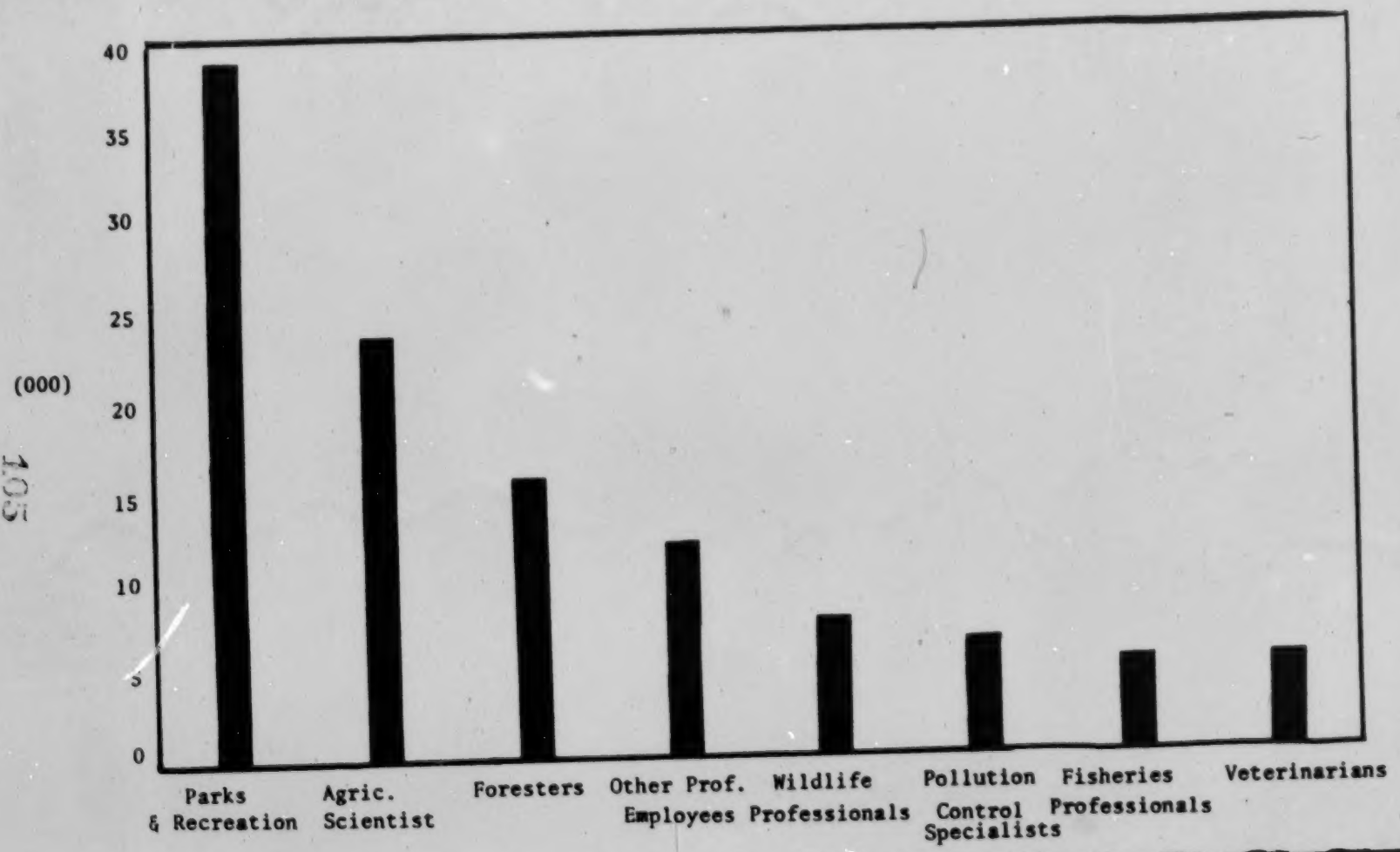

Table 44 -- Agriculture and Natural Resources Professional Employment in Government Agencies, by Category, U.S.

	1960	1970	1980
Agricultural Scientists	14,705	17,195	23,430
Agricultural Engineers	1,395	1,510	1,855
Veterinarians and Veterinary Scientists	3,235	4,665	5,750
Foresters	9,270	11,590	16,405
Parks and Recreation Professionals	10,535	22,905	38,950
Fisheries Professionals	1,820	3,550	5,920
Wildlife Professionals	5,590	6,465	7,485
Pollution Control Specialists	1,565	3,040	6,205
Landscape Architects	930	1,865	3,490
Laboratory Animal Management Professionals	190	265	535
Other Professional Manpower	9,035	10,940	12,755
TOTAL	58,270	83,990	122,780

Managers and administrators, and sales managers and salesmen will continue to represent by far the largest number of professional manpower in agriculture and natural resources.

Figure 45 -- Professional Employment in Business and Industry, By Category, U. S., 1980

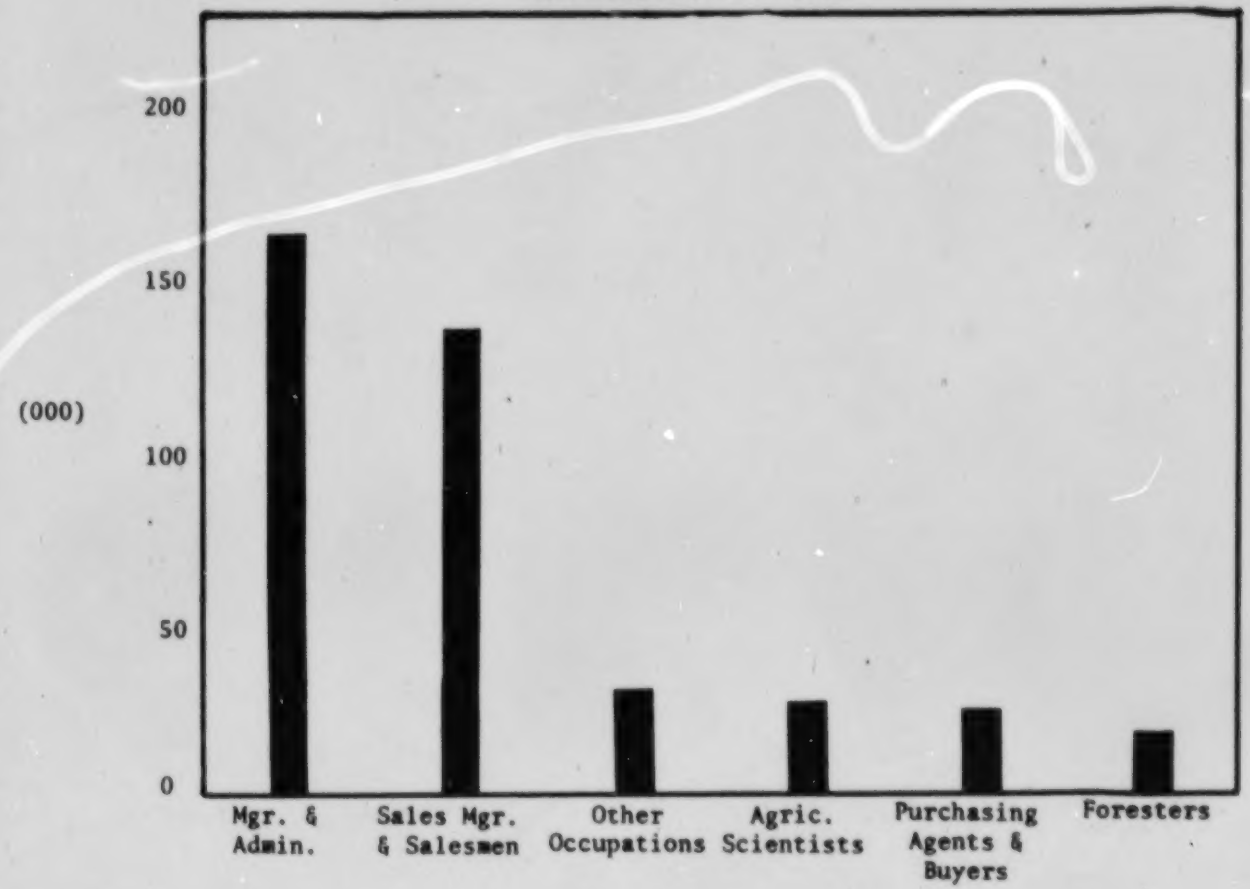

Table 45 -- Agriculture and Natural Resources Professional Employment in Business and Industry, by Category, U.S.[1]

	1960	1970	1980
Agricultural Scientists	15,100	20,200	27,580
Agricultural Engineers	9,480	10,270	12,640
Veterinarians[1]	605	850	2,100
Foresters	6,850	12,255	18,485
Parks and Outdoor Recreational Professionals	1,590	3,460	5,870
Fisheries Professionals	575	1,125	1,875
Wildlife Professionals	745	865	1,000
Purchasing Agents and Buyers	11,465	16,925	24,970
Sales Managers and Salesmen	57,205	84,575	134,785
Managers and Administrators, Other	74,850	110,900	163,590
Pollution Control Specialists	2,580	5,025	10,255
Landscape Architects	1,475	2,950	5,530
Laboratory Animal Management Professionals	185	265	535
Other Occupations[2]	9,980	21,065	31,755
TOTAL	192,685	290,730	440,970

1. Excludes veterinarians in private practices, includes consultants and other private practice.
2. Includes finance and credit, and communication and advertising personnel.

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Employment in management, sales, and related occupations in agricultural-natural resources business and industry will increase by at least 50 percent from 1970 to 1980.

Figure 46 -- College Graduates in Management, Sales and Related Occupations in Agribusiness, U. S.

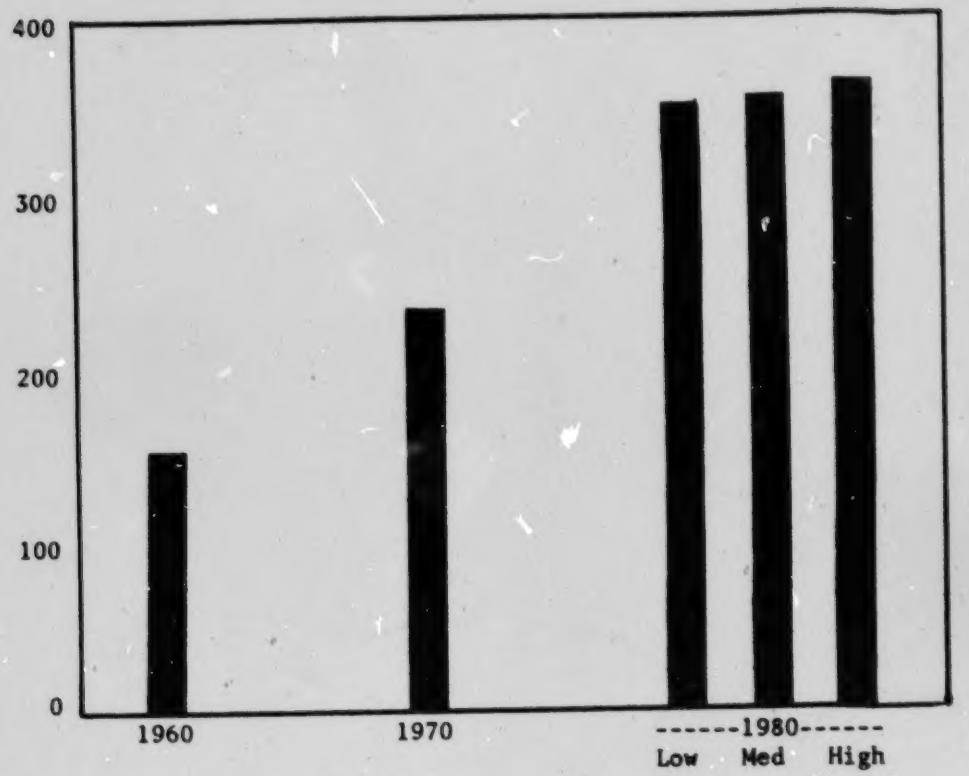

Table 46 -- College Graduates in Management, Sales and Related Occupations in Agribusiness, U.S.

	1960	1970	1980		
Managers and Administrators (excluding Sales & Finance)	74,850	110,900		163,590	
Sales Managers and Salesmen	57,205	84,575		134,785	
Purchasing Agents and Buyers	11,465	16,925		24,970	
Finance and Credit Personnel[1]	5,520	8,115		11,970	
Communications and Advertising Personnel[2]	4,460	12,950		19,785	
TOTAL	153,500	233,465	350,200[3]	355,100[4]	362,530[5]
Percent Increase	---	52.1	50.0	52.1	55.3

1. Financial managers and credit men in industry, and agricultural working officials.
2. Editors and writers, public relations and publicity personnel, and advertising agents and salesmen in industry and in specialized firms.
3. Based on survey of agribusinesses in spring, 1971, by Dr. E. E. Darrow, College of Agriculture and Home Economics, The Ohio State University.
4. Same percentage increase as 1960-70.
5. Based on projected increase in U.S. managerial and sales manpower, and trends in the percentage of positions occupied by college graduates.

Sources: U.S. Bureau of the Census, U.S. Department of Labor, The National Future Farmer, and Horticultural Research Institute, Inc.

Retailing, processing and wholesaling are among the agribusinesses which employ the greatest number of college graduates in management, sales and related occupations.

Figure 47 -- College Graduates in Management, Sales and related occupations in Agribusiness, by Selected Industry, U. S., 1970

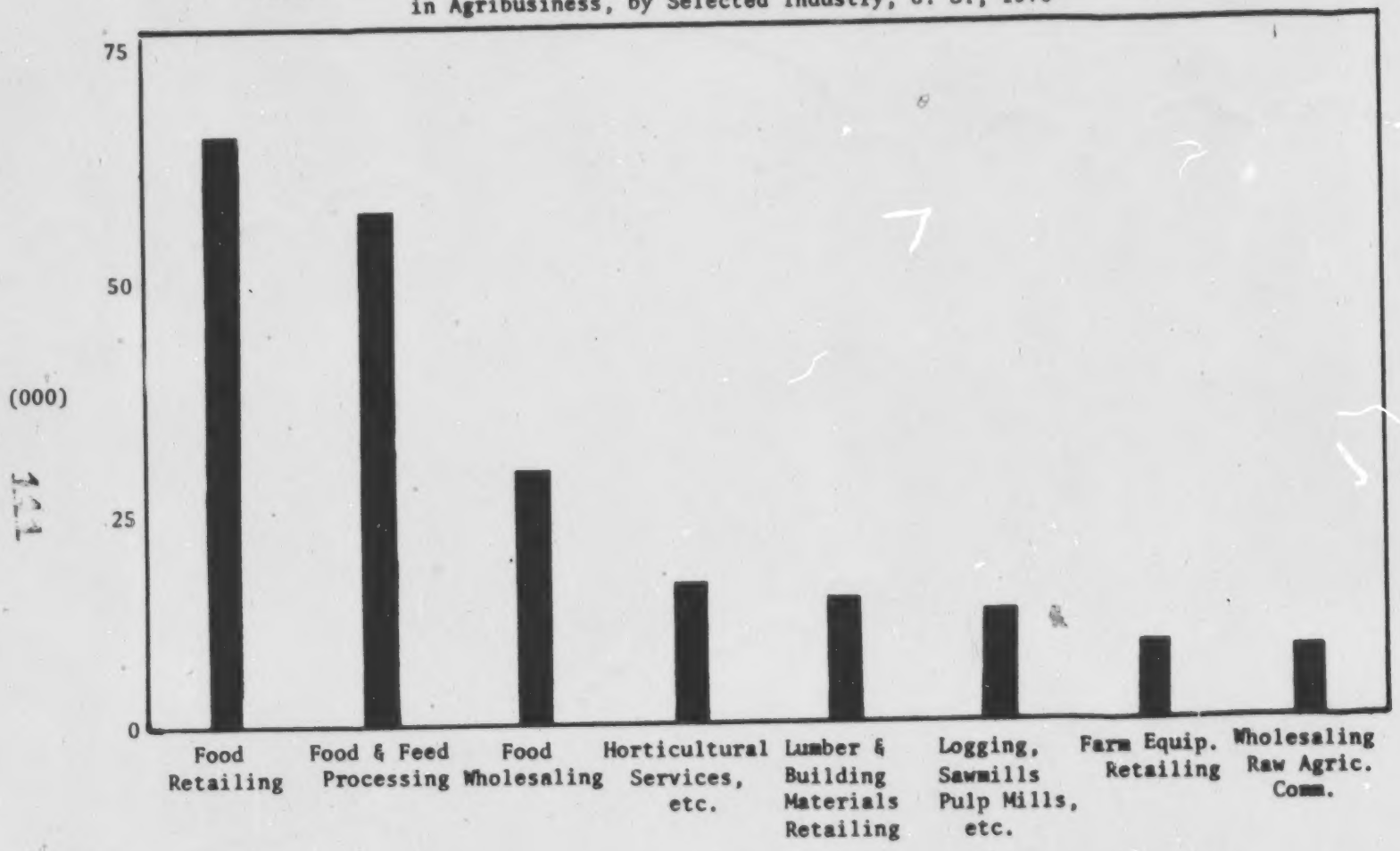

Table 47 -- College Graduates in Management, Sales and Related Occupations in Agribusiness, by Selected Industry, U.S., 1970

Food Retailing	63,910	Farm Equipment Retailing	8,550
Food and Feed Processing	53,955	Wholesaling of Raw Agricultural Commodities	8,090
Food Wholesaling	34,275	Yarn and Knitting Mills, etc.	7,190
Horticultural Services, Nursery, Retail and Wholesale Floriculture	15,220	Farm and Garden Stores	4,605
Lumber and Building Materials, Retailing	13,625	Agricultural Production (excluding farms), Agricultural Services (excluding horticulture), Forestry, Fisheries	4,360
Logging, Sawmills, Pulp, Land Paper Mills, etc.	11,955		

The number of agricultural scientists in the U. S. rose 61 percent from 1960 to 1970, and will increase 36 percent more by 1980.

Figure 48 -- Agricultural Scientists, U. S.

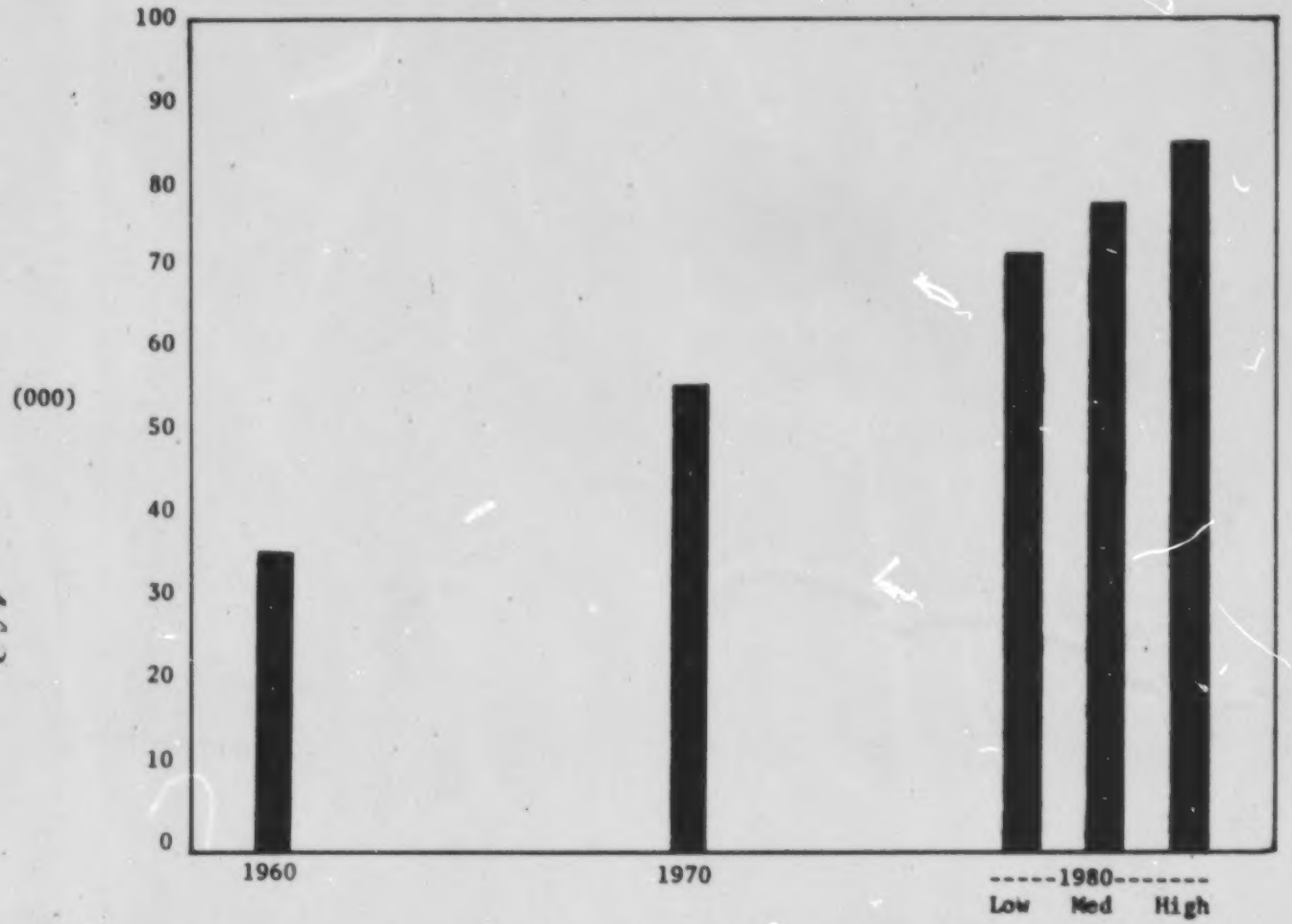

Table 48 -- Agricultural Scientists, U.S.[1]

	1960	1970	1980[2]		
Universities and Colleges[3]	6,665	21,210		28,930	
Business and Industry[4]	15,100	20,200		27,580	
Federal Government[5]	12,395	14,165		19,345	
State and Local Government, and Nonprofit Organizations[6]	2,310	3,030		4,085	
TOTAL	36,470	58,605	71,945[7]	79,940	87,935[7]

1. "Agricultural Scientists" includes all faculty in agricultural experiment stations, cooperative extension services, and resident instruction in colleges of agriculture, in addition to persons engaged primarily in research and development in business and industry, government agencies, and private, nonprofit organizations (with exceptions as noted). Includes biological, physical and social scientists. Excludes scientists in forestry, fisheries, wildlife, parks and outdoor recreation and veterinary science, all of which are included in other appropriate tables.

2. Distribution by category: Same as 1970.

3. Includes all faculty in agricultural experiment stations; cooperative extension services; and colleges, schools and departments of agriculture which offer baccalaureate and advanced degree programs.

4. Includes those identified as "agricultural scientists" by the National Science Foundation; plus biologists and chemists employed in agricultural-related industries, as reported by NSF; and estimates of the numbers of agricultural social scientists, which are not included in the NSF report.

5. Includes those identified by NSF as "agricultural scientists" in all federal agencies, plus other physical scientists and mathematicians, biologists, and social scientists employed by the U.S. Department of Agriculture and the U.S. Department of Interior. May include some not engaged in research and development per se -- e.g. some in soil conservation and other occupations.

6. Private nonprofit organizations account for only about 100 scientists included in this category. The category includes those identified as "agricultural scientists" by the National Science Foundation, plus an estimate for social scientists.

7. Ten percent variance.

Sources: National Science Foundation, "Employment of Scientists and Engineers in the United States, 1950-66," NSF 68-30, September, 1968. National Science Foundation, "Scientific and Technical Personnel in the Federal Government," annual series. Data for 1970 are extrapolated from 1950-66 trends, except in the case of Federal Government. Median projection for 1980 is based on unpublished data from NSF.

4.15

Employment of agricultural engineers will rise by nearly one-fourth from 1970 to 1980.

Figure 49 -- Agricultural Engineers, U. S.

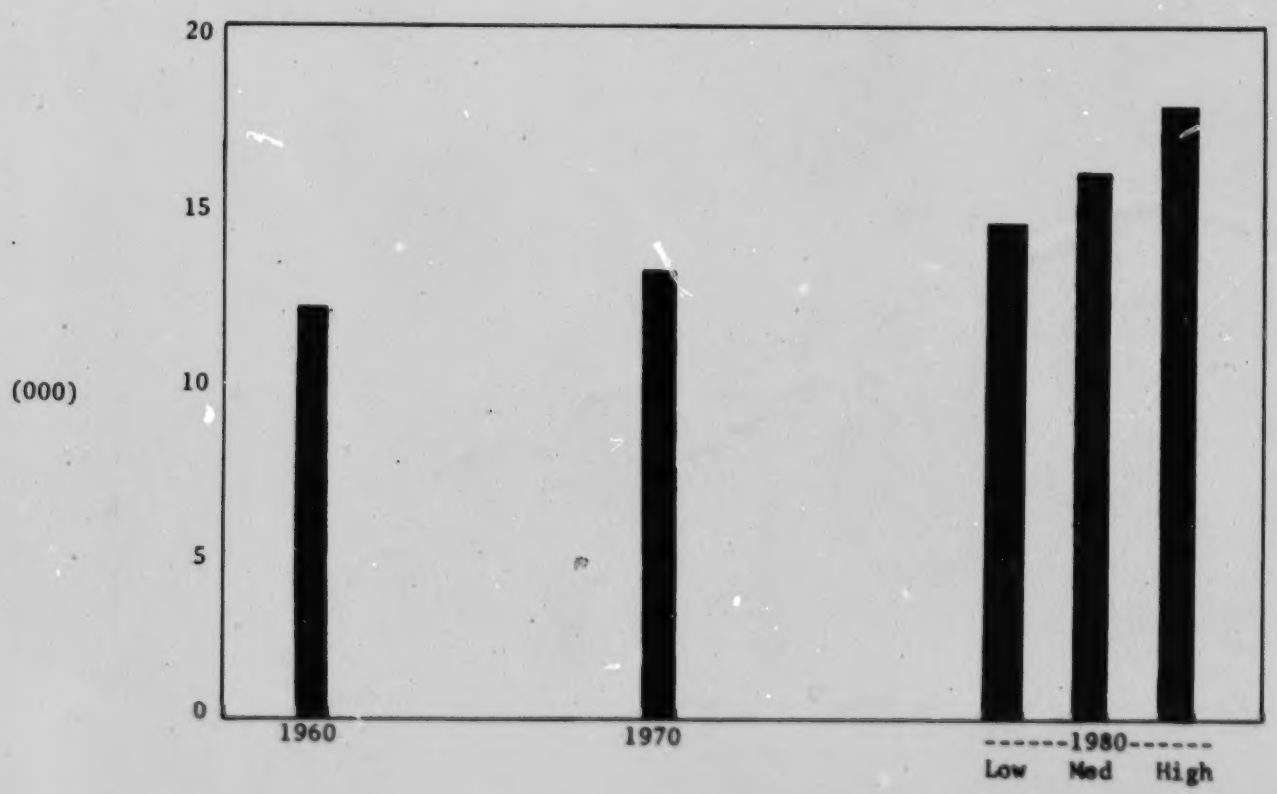

Table 49 -- Agricultural Engineers, U.S.

	1960[1]	1970[2]	1980[2]		
Industry	9,480	10,270	12,640		
Federal Government	1,305	1,410	1,730		
State and Local Government	90	100	125		
Educational Institutions	1,125	1,220	1,505		
TOTAL	12,000[3]	13,000	14,500[4]	16,000[5]	17,725[6]

1. Breakdown by employment category based on 1970 distribution.
2. Source: J. L. Butt, American Society of Agricultural Engineers, personal communication.
3. Based on 1968 estimate of 12,000 (Department of Labor) and "little change from 1960 to 1970" (J. L. Butt).
4. Source: U.S. Department of Labor, Occupational Outlook Handbook, 1972-3.
5. Source: J. L. Butt.
6. Based on NSF projections for all engineers.

Demand for teachers of vocational agriculture will increase by as much as one-third from 1970 to 1980.

Figure 50 -- Teachers of Vocational Agriculture, U. S.

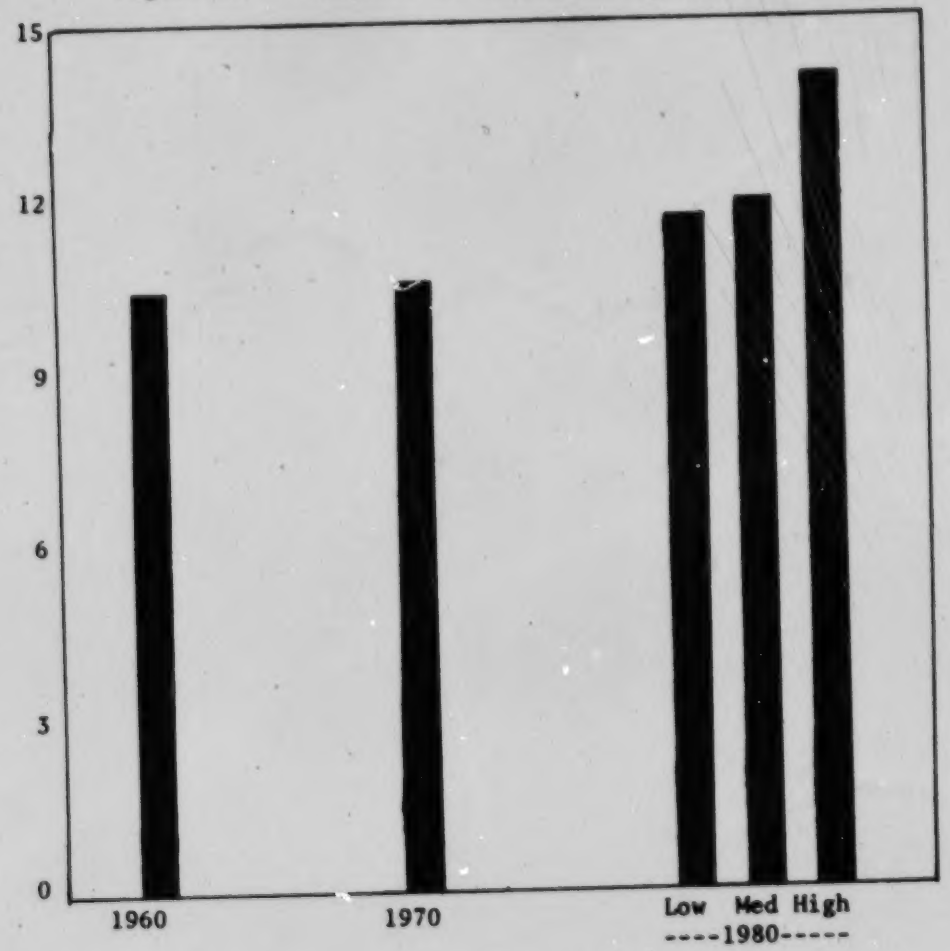

Table 50 -- Teachers of Vocational Agriculture, U.S.

	1960	1961	1965	1966	1967	1968	1969	1970	1971	1972	1975	1980		
Teachers	10,500[1]	10,620	11,055	10,325	10,221	10,412	10,560	10,520	10,438	10,716	11,977	11,665[2]	11,975[3]	14,080[4]
Replacements required	NA	NA	1,003	1,077	1,104	942	1,181	1,029	984	1,206	1,198	1,180	1,210	1,420
Percent of Total			9.1	10.4	10.8	9.0	11.2	9.8	9.4	11.3	10.1[5]	10.1[5]	10.1[5]	10.1[5]
Teachers needed but not available								171		134				
Departments not opened because of teacher shortage								52		74				
Number of Positions								10,691[6]		10,850[6]				

1. Extrapolated, based on 1961-5 growth.
2. Continuation of 1970-2 percentage increase in number of positions.
3. Same as projected for 1975.
4. Extrapolation of 1972-5 projection.
5. 1965-72 average.
6. Number of teachers plus number of teachers needed but not available.

Source of historic and 1975 data: Woodin, Ralph J., "Supply and Demand for Teachers of Vocational Agriculture in the United States," Annual Survey (Department of Agricultural Education, The Ohio State University).

Employment of faculty in two-year technical programs in agriculture and natural resources rose very rapidly during the 1960's, and will nearly triple during the 1970's.

Figure 51 -- Faculty in Two-year Technical Programs in Agriculture and Natural Resources, U. S.

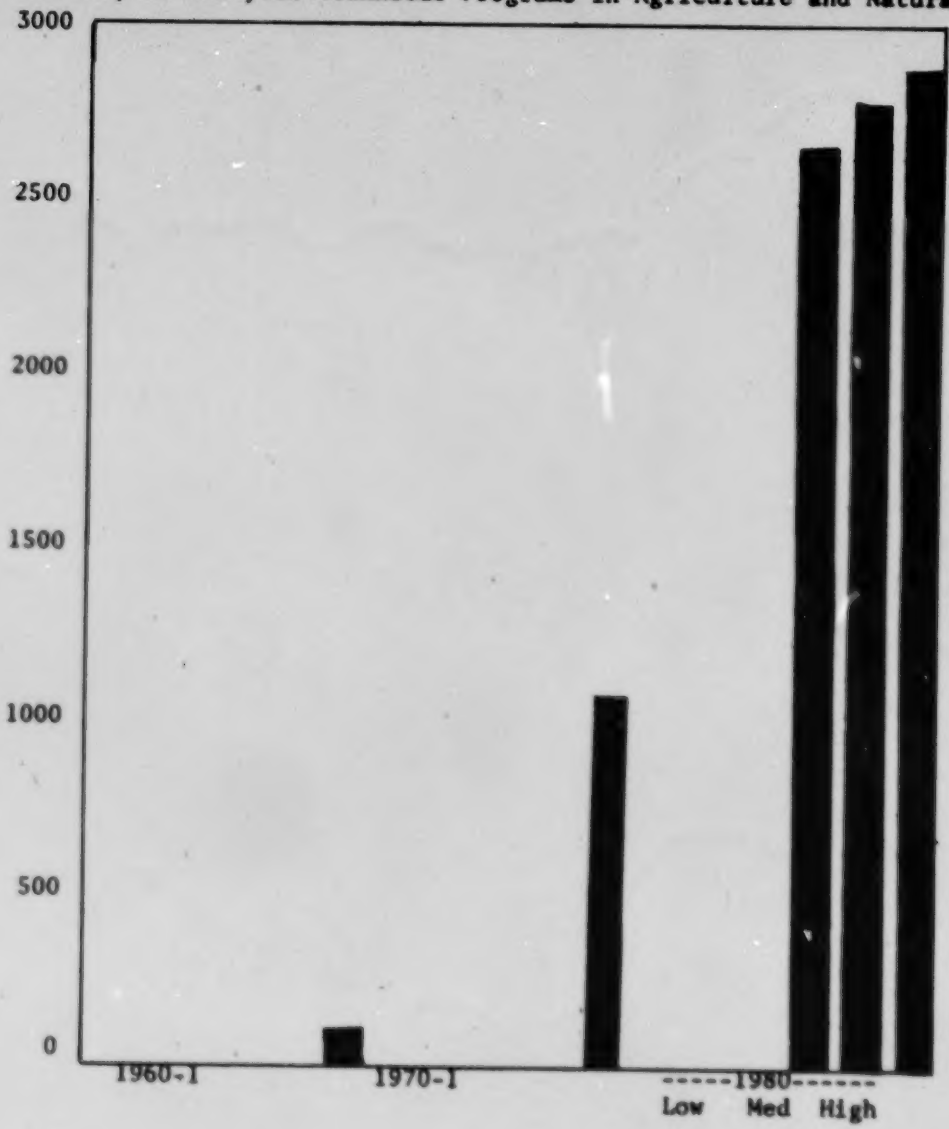

Table 51 -- Two-Year Technical Programs in Agriculture and Natural Resources, U.S.

	1960-1	1966-7[1]	1967-8[1]	1968-9[1]	1969-70	1970-1	1971-2[2]	1980-1 Low[3]	1980-1 Medium[4]	1980-1 High[5]
Enrollment	NA	10,290	13,786	18,434	NA	NA	32,622	69,525	72,820	75,185
Number Institutions Offering Programs	NA	142	197	243	NA	NA	383			
Number Programs Offered	NA	385	500	608	NA	NA	855			
Faculty	100[6]	393	527	716	NA	1060[7]	1235	2,665	2,790	2,880
Students per Teacher	NA	26.2	26.2	25.7	NA	NA	26.4	26.1[8]	26.1[8]	26.1[8]

1. Source: Manley, Fred William, "Two-Year Technical Education Curricula in Agriculture and Natural Resources in the U.S.A.," Annual Surveys.
2. Source: Iverson, Maynard J., "Directory of Post-Secondary Education in Agribusiness and Natural Resources Occupations, 1971-2," Vocational Education Department, College of Education, University of Kentucky, January, 1972.
3. Extrapolation of 1966-9 to 1971-2 trend.
4. Extrapolation of trend from 1966-7 to 1971-2.
5. Extrapolation of trend from 1968-9 to 1971-2.
6. Estimated, based on trend from 1966-7 to 1971-2.
7. Interpolated on the basis of trend from 1968-9 to 1971-2.
8. Average of 4 known years.

NA = not available.,

The number of U. S. farmers who have college degrees rose 42.5 percent from 1960 to 1970, and will increase by the same percentage from 1970 to 1980.

Figure 52 -- Farmers with College Degrees, U. S.

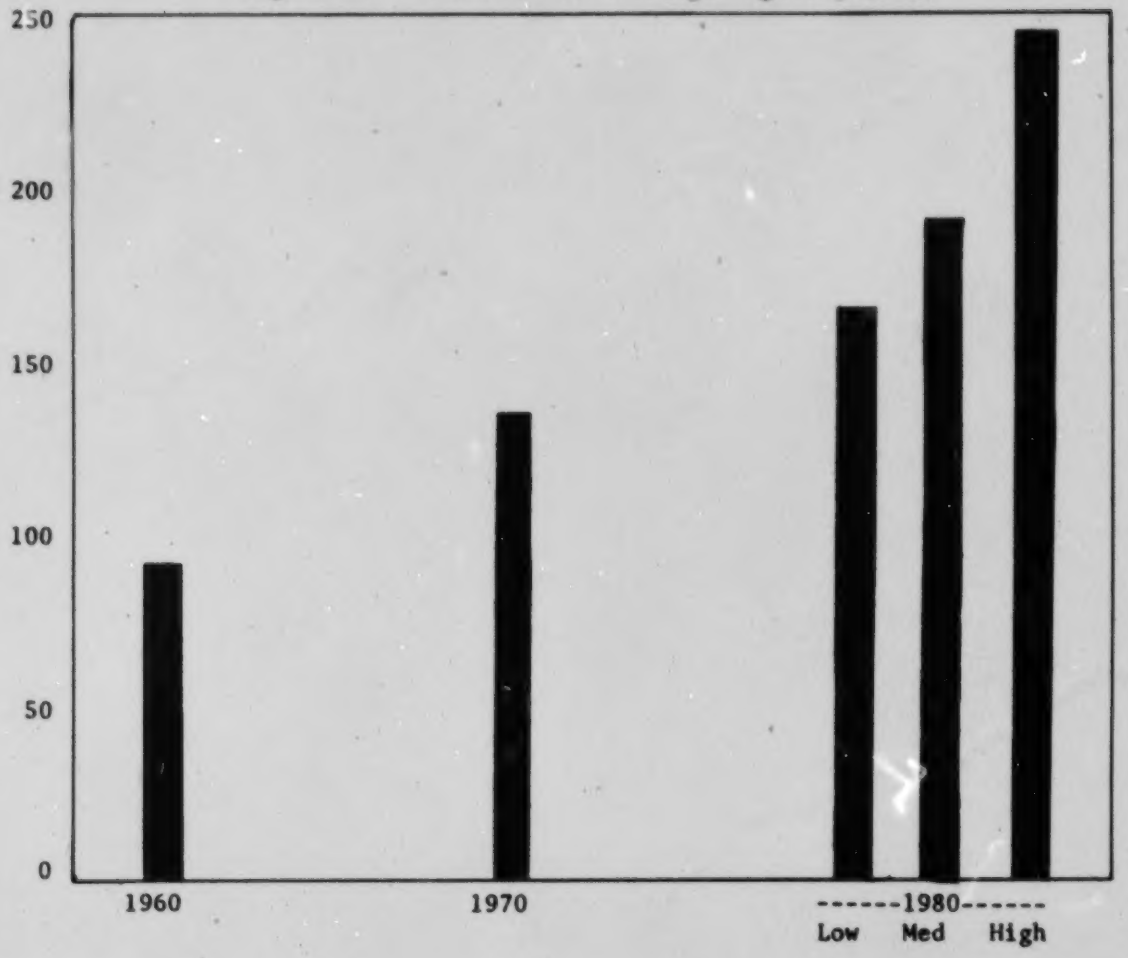

Table 52 -- Farmers With College Degrees, U.S.

(000)

	1960	1970	1980		
Total Farm Operators	2,450.0[1]	1,500.0[2]	1,180.0[2]		
Rural Farm Males With 4 or More Years of College	94.4[1]	134.6[1]	167.0[3]	191.6[4]	247.8[5]
Percent of Farm Operators With 4 Years or More of College	3.9	9.0	14.2	16.2	21.0

1. Source: Census of Agriculture.
2. Source: Lee, John E., Jr., "Input Requirements of the Food Industry," Economic Research Service, USDA, February 21, 1973.
3. Assumes that 14.2 percent of all farm operators will have degrees (same numerical increase in percentage from 1970 to 1980 as from 1960 to 1970).
4. Same percentage increase in number as 1960 to 1970.
5. Same percentage increase in proportion as from 1960 to 1970.

Note: It is not the position of the authors that only those farmers with college degrees are "professional." Instead, the number of farmers with college degrees is taken as the best available numerical indicator of the growing professionalization of farming, and as an indication of the need for college graduates in production agriculture.

The need for veterinarians in the U. S. will increase by 62.5 percent during the decade of the 1970's.

Figure 53 -- Number of Veterinarians and Veterinary Scientists, U. S.

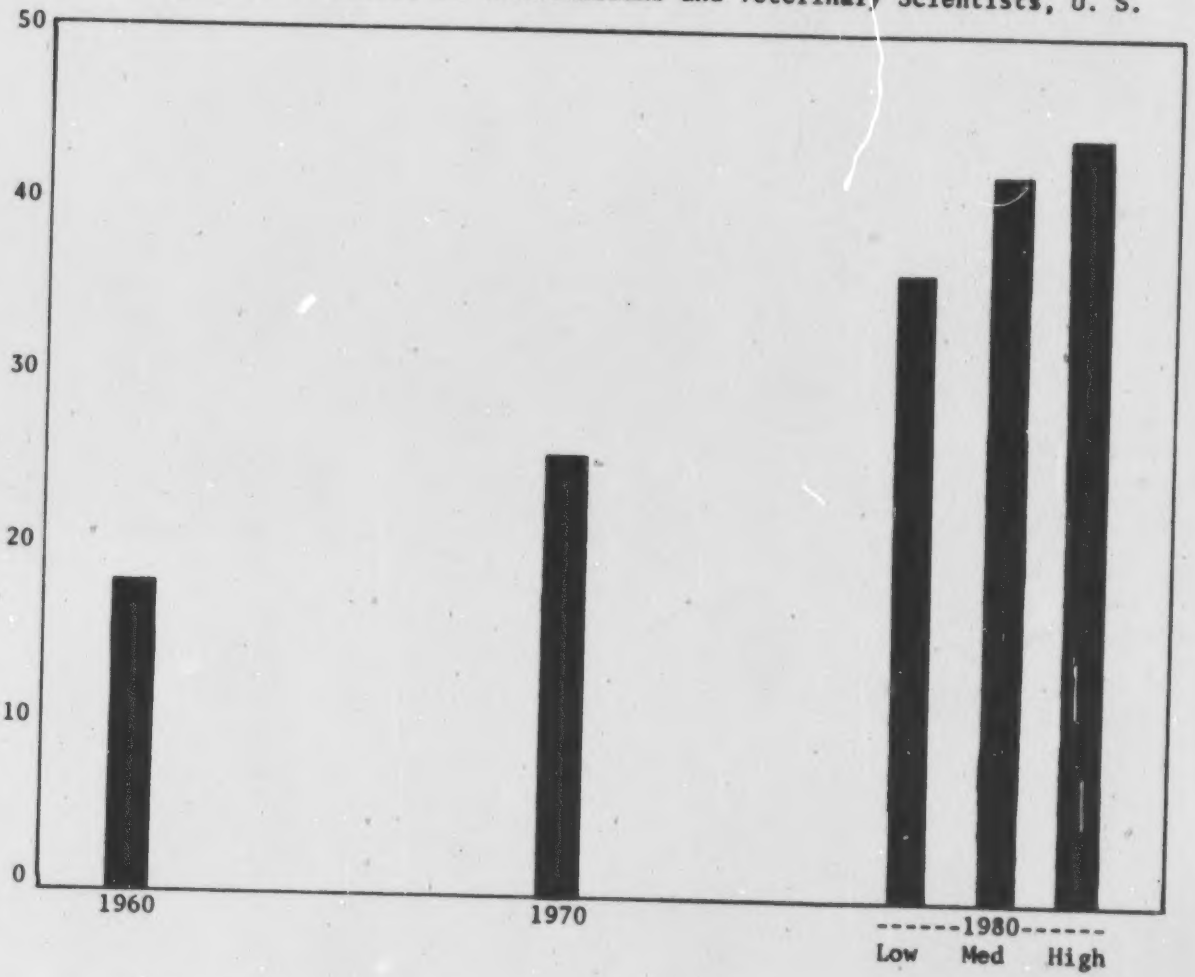

Table 53 -- Veterinarians and Veterinary Scientists, U.S.

Major Activity	1960	1970	1980		
Large animal and poultry practice (excluding horses)	NA	6,242		6,250	
Small animal practice (pets)	NA	10,931		21,900	
Equine practice	NA	804		1,600	
Laboratory animal medicine	NA	342		700	
Zoo animal practice	NA	40		80	
Wildlife animal practice	NA	14		50	
Public health	NA	276		570	
Military veterinary medicine (exclusive of laboratory animal medicine and research)	NA	770		450	
Regulatory veterinary medicine (other than meat inspection)	NA	1,227		1,900	
Meat inspection	NA	1,885		1,900	
Industrial veterinary practice (exclusive of laboratory animal medicine)	NA	506		1,400	
Teaching and research (exclusive of laboratory animal medicine, public health, and industrial veterinary practice)	NA	1,611		3,200	
Other veterinary practice	NA	477		770	
TOTAL	17,145[1]	25,100	36,745[2]	40,800	44,880[3]

1. Based on change in number of veterinarians as reported in the 1960 and 1970 censuses of population.
2. Same percentage increase as 1960-70.
3. Ten percent above medium projection.

NA = not available.

Source of all other data: National Academy of Sciences - National Research Council, Washington, D.C., "New Horizons for Veterinary Medicine," 1972.

Employment of professional foresters will increase by 45 percent from 1970 to 1980.

Figure 54 -- Professional Foresters, U. S.

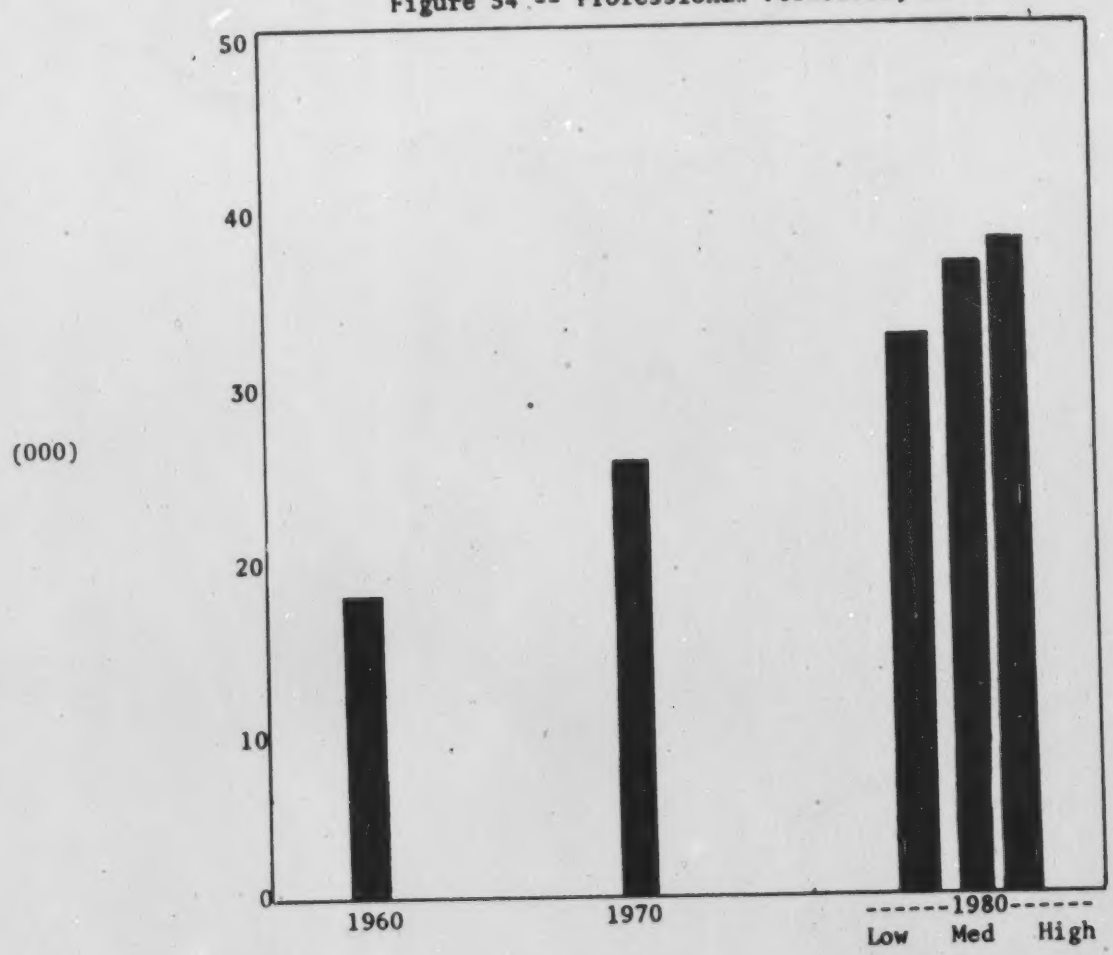

Table 54 -- Professional Foresters, U.S.

	1960[1]		1970			1980	
	Number	Percent of Total	Number	Percent of Total		Number	Percent of Total
Public							
Federal Government	6475	37.6	7920[2]	31.7		10845[8]	29.9
State Government	2600	15.1	3120[3]	12.5		4370[9]	12.0
County and Municipal	190	1.1	550[4]	2.2		1190[8]	3.3
Subtotal	(9270)	(53.8)	(11590)	(46.4)		(16405)	(45.2)
Private (industry, consulting, associations, etc.)	6850	39.8	12255[6]	49.0		18485[8]	51.0
Educational Institutions	1105	6.4	1155[5]	4.6		1385[9]	3.8
Total Employed	17225	100.0	25000[7]	100.0	(Low)	32000[11]	100.0
					(Medium)	36275[10]	
					(High)	37000[12]	

1. Source: Based on 1961 survey by Society of American Foresters.

2. Number of foresters in Federal Government calculated as follows:

	1960	1970
Foresters in federal government, from animal survey by National Science Foundation Annual Survey.	4900	6000
Total foresters in federal government (1960 figure from SAF Survey).	6475	7920

3. Source: "Forestry Employment by the States," Journal of Forestry, December, 1972. Survey indicated 3,237 foresters in state agencies in 1972; figure shown was interpolated for 1970 based on 1960-72 growth.

4. Estimated.

5. Source: "Forester Employment in Academia," Journal of Forestry, January, 1973. Survey indicated 1,167 foresters in technical institutes, colleges and universities in 1972; figure shown was interpolated for 1970 based on 1960-72 growth.

6. Balance remaining after all other categories were accounted for.

7. Source: Society of American Foresters.

8. Estimated, based on balance remaining after all other categories were accounted for.

9. Based on estimates of new positions with "dramatic" recovery in the economy (Journal of Forestry, prev. cit.). Year in which new level of positions would be reached was not indicated.

10. Assumes same percentage increase as 1960-70.

11. U.S. Department of Labor, Bureau of Labor Statistics, "Occupational Manpower and Training Needs," Bulletin 1701, 1971.

12. Source: Fanning, Odom, "Opportunities in Environmental Careers," Universal Publishing and Distributing Corp., 1972.

Professional employment in parks and recreation tripled from 1950 to 1970, and will increase 70 percent more by 1980.

Figure 55 -- Professional Personnel in Parks and Recreation, U. S.

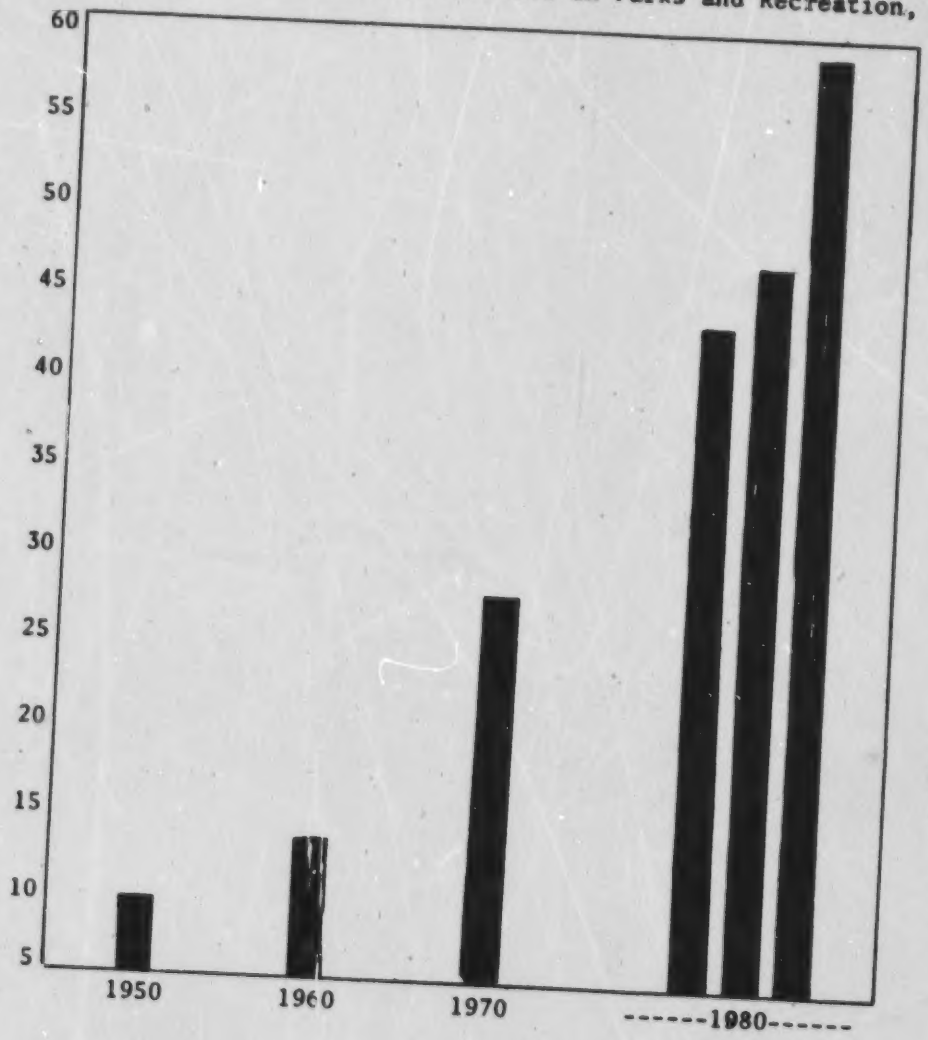

Table 55 -- Professional Personnel in Parks and Outdoor Recreation, U.S.

	1950	1960	1970	1980		
Municipal and County Government	6,785	9,215	17,285			
State Government	400	730	3,390	38,950		
Federal Government[1]	350	590	2,230			
Private Nonprofit and Commercial[2]	1,140	1,590	3,460	5,870		
Educational Institutions[3]	685	830	1,265	2,150		
TOTAL	9,360	12,955	27,630	43,100	46,970	58,900
Percent Increase	--	38.4	113.3	56.0[4]	70.0[5]	113.2[5]

1. Estimated, based on salary and wage expenditure in relation to state expenditures.
2. 1970--based on data from National Recreation and Parks Association; 1950 and 1960--same percentage of public as in 1970.
3. Same percentage of total as in forestry.
4. Based on low projection of recreation visits.
5. Based on historic trends, and projections of salary and wage expenditures and recreation visits.

Other Data: From Statistical Abstract.

4.30

Professional employment in fisheries will increase by more than 50 percent from 1970 to 1980.

Figure 56 -- Professional Employment in Fisheries

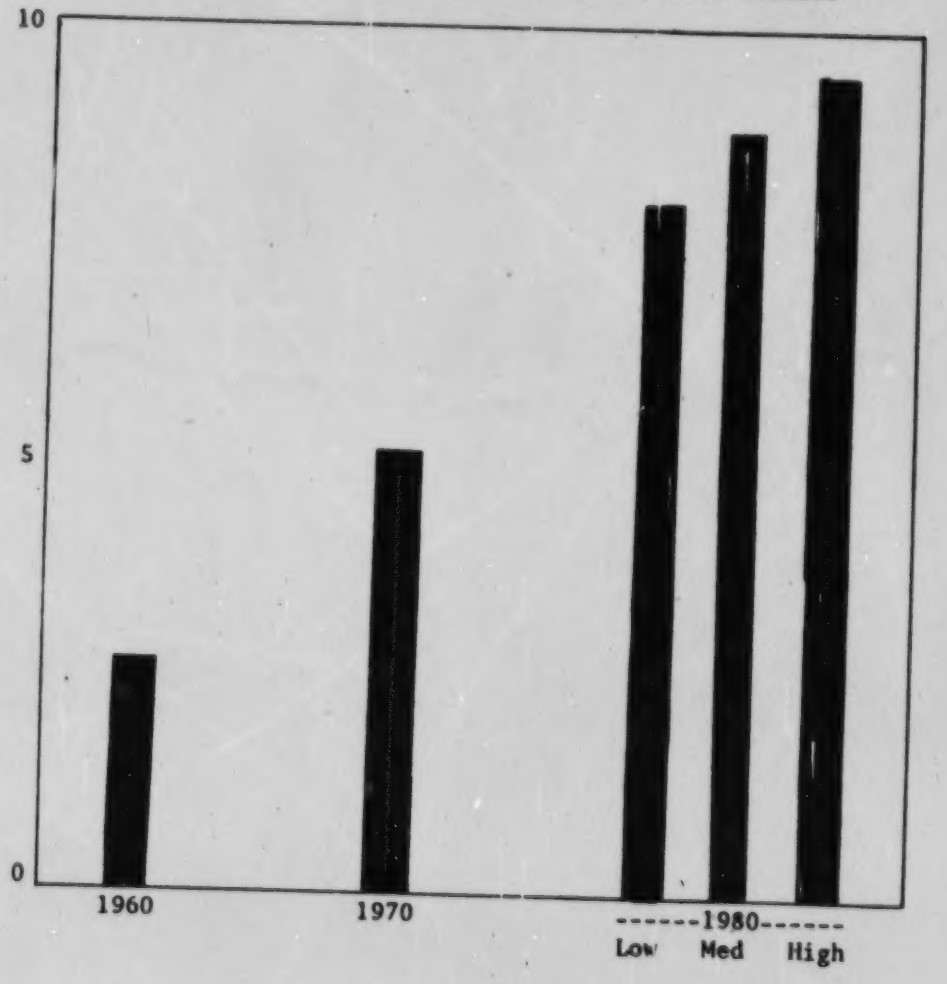

Table 55 -- Professional Employment in Fisheries

	1960[1]	1970	1980[1]		
Federal Government	795	1,550	2,585		
State and Local Government	1,025	2,000	3,335		
Educational Institutions	305	600	1,005		
Private	575	1,125	1,875		
TOTAL	2,700[2]	5,275[3]	7,965[4]	8,800[5]	9,500[6]

1. Distribution by category based on 1970.
2. Based on 1960-70 growth in federal employment, as reported by the National Science Foundation.
3. Source: "Items for Fishery Scientists," Sport Fishing Institute, Washington, D.C., Jan.-Feb., 1971.
4. Six hundred positions available per year (Sport Fishing Institute) less replacements at 4 percent per year.
5. Fanning, Odom, "Opportunities in Environmental Careers," Universal Publishing and Distributing Corp., 1972.
6. See footnote 3.

4.32

Professional employment in wildlife will increase by one-third during the seventies.

Figure 57 -- Professional Employment in Wildlife

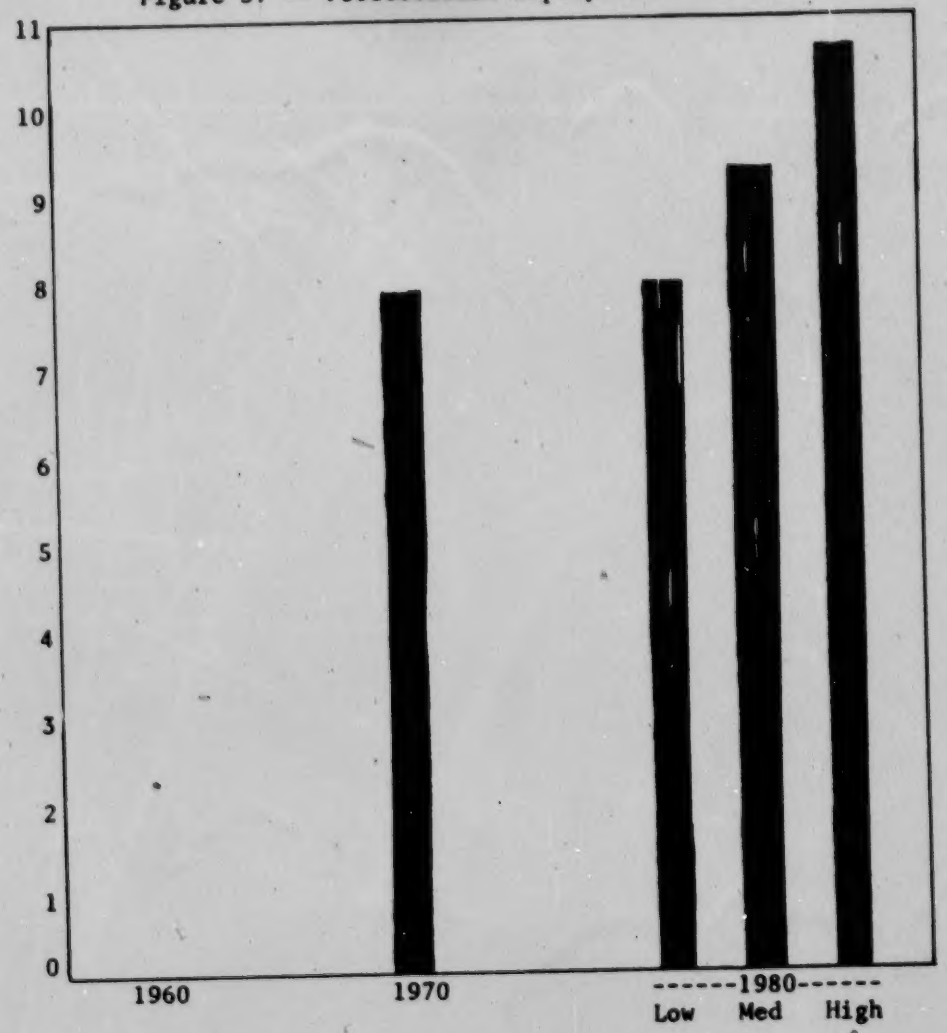

Table 57 -- Professional Employment in Wildlife

	1960[1]	1970	1980[1]		
Federal Government	1,295	1,500[2]	1,735		
State Government	4,295	4,965[3]	5,750		
Colleges and Universities	560	650[4]	750		
Private Employers	745	865[5]	1,000		
TOTAL	6,895[6]	7,980	7,980[7]	9,235[8]	10,615[9]

1. Distribution by category based on 1970 employment.
2. Based on estimates obtained in a survey by the Wildlife Society (The Wildlife Society News, August, 1969).
3. Based on a survey by the Wildlife Society, prev. cit., and by Morse, William B., "Law Enforcement--One Third of the Triangle," Wildlife Society Bulletin, Vol. 1, No. 1, Spring, 1973.
4. Based on a survey by the Wildlife Society, and placement surveys (1969 and 1971) by the Society.
5. Based on the Wildlife Society placement surveys.
6. Derived from 1960-70 ratio in active or regular membership in The Wildlife Society.
7. "Lowest Likely" -- Fred G. Evendon, The Wildlife Society.
8. Same percentage increase as from 1960 to 1970.
9. Based on percentage increase, 1970 to 1980, project by: Fanning, Odom, "Opportunities in Environmental Careers," prev. cit.

Need for scientific and engineering manpower in pollution control related to agriculture and natural resources will double during the 1970's

Figure 58 -- Agricultural and Natural Resources Scientific and Engineering Manpower in Pollution Control, U. S.

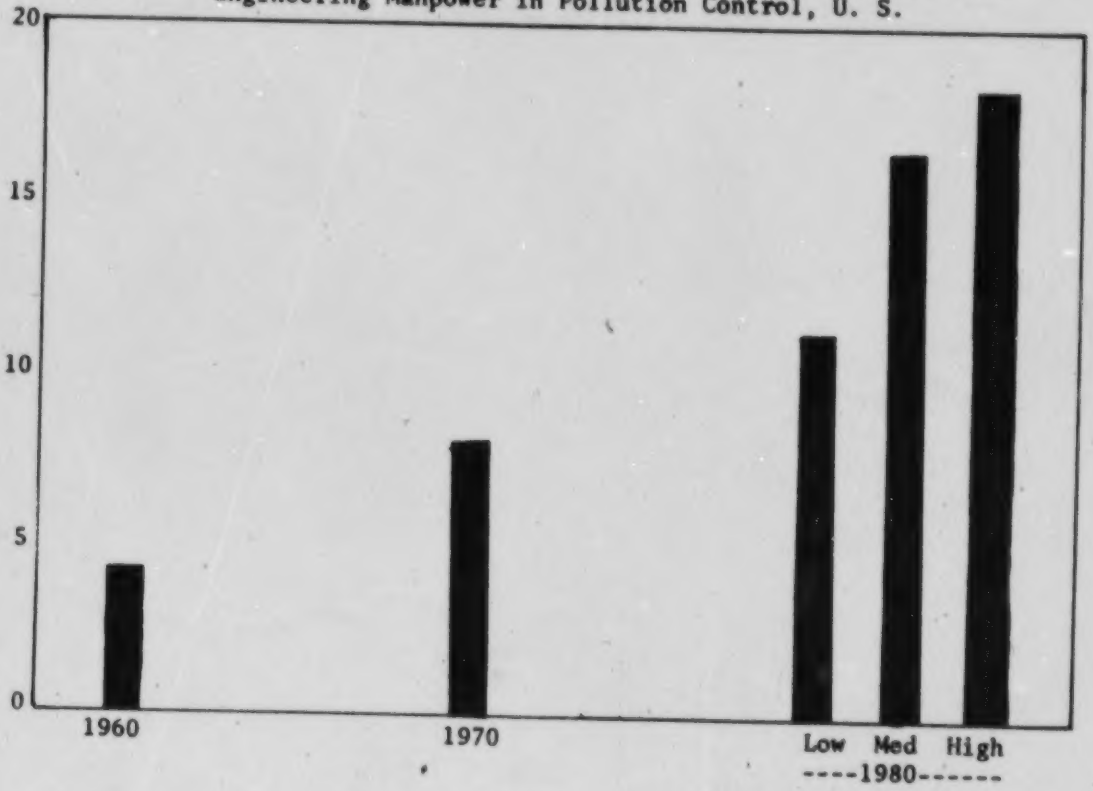

Table 58 -- Agricultural and Natural Resources Scientific and Engineering Manpower in Pollution Control, U.S.

	1960	1970	1980		
Total Scientific and Engineering Manpower[1]					
Air Pollution Control	2,800	7,175	25,000		
Solid Waste Management	14,200	20,200	26,200		
Water Pollution Control	9,400	24,000	53,640		
TOTAL	26,400	51,375	104,840		
Related to Agriculture and Natural Resources					
Air, Solid Waste, Water Pollution[2]	4,145	8,065	16,460		
Other--Pesticides, Fertilizer, Animal Waste, etc.[3]	4,145	8,065	16,460		
TOTAL	8,290	16,130	32,920		
Not included in other tables[4]	4,145	8,065	11,060[5]	16,460	18,100[6]

1. From Middlebrook, Kolb and Ettelstein, "Manpower Needs in Environmental Engineering," American Society for Engineering Education, 1973.
2. Portion of total derived by analysis of data contained in: Lewis, James E., "Water-Resources Manpower Supply and Demand Patterns to 1980," Bulletin of Louisiana Water Resources Research Institute, Louisiana State University, May, 1970.
3. Assumed to equal the number in air, solid waste and water pollution.
4. Assumes 50 percent of the manpower is accounted for in other categories, such as agricultural scientists, and agricultural engineers.
5. Based on increase projected by Fanning, prev. cit., for all pollution control categories.
6. Ten percent variance.

Employment of landscape architects who are engaged in agriculture and natural resources - related work will nearly double from 1970 to 1980.

Figure 59 -- Landscape Architects in Agricultural and Natural Resources-related Work, U. S.

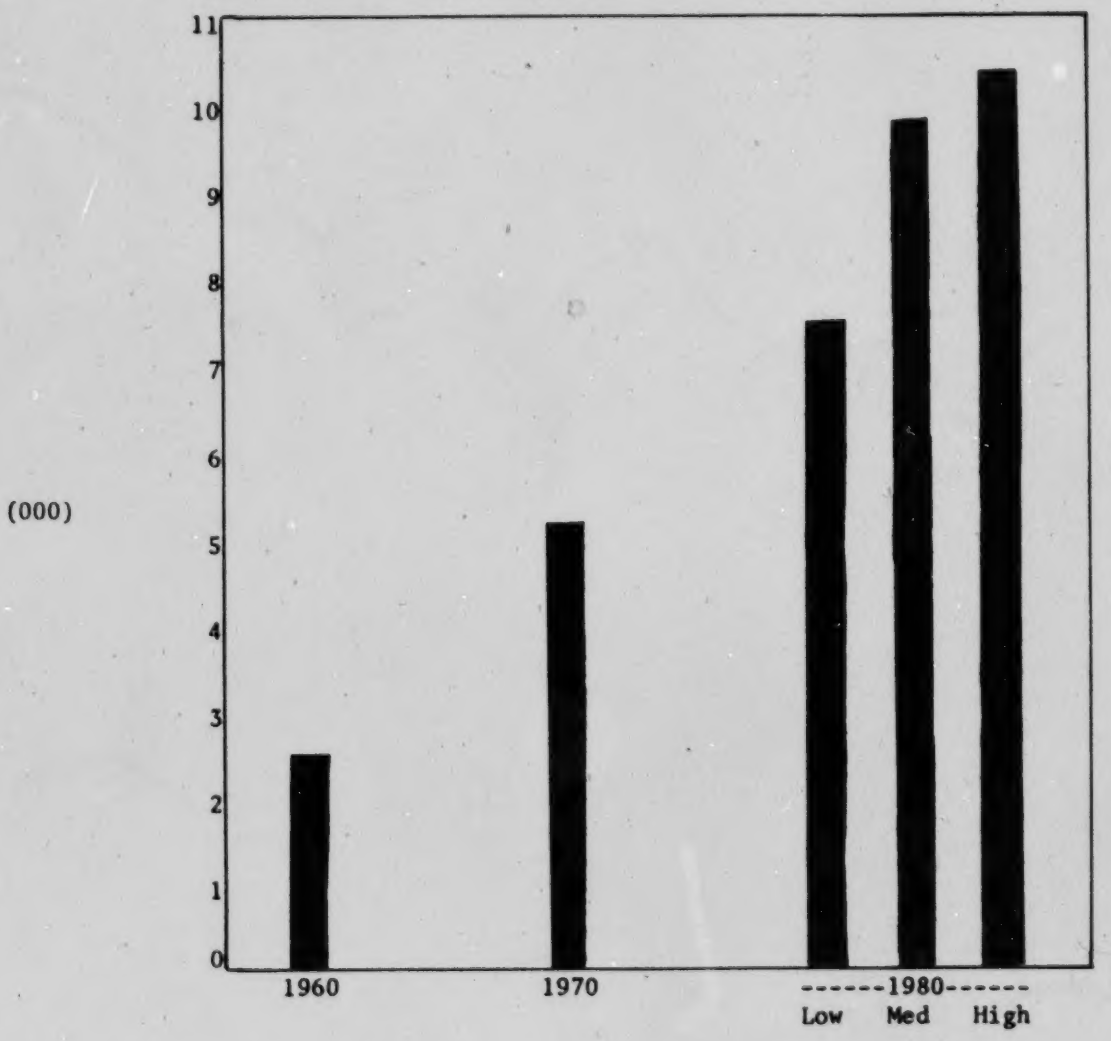

Table 59 -- Landscape Architects, U.S.

	1960[1]	1970[2]	1980[1] Low	1980[1] Medium	1980[1] High
Total Number	4,000[3]	8,000[4]	11,500[5]	15,000[6]	16,000[7]
Primarily Employed in Agricultural and Natural Resource-Related Work[8]	2,585	5,175	7,435	9,700	10,350
Private Sector[9]	1,475	2,950		5,530	
Federal Government	440	880		1,650	
State Government	155	310		580	
Local Government	335	675		1,260	
Educational Institutions	180	360		680	

1. Distribution by employment area based on employment pattern in 1970.
2. Distribution by employment category: from 1969 survey by American Society of Landscape Architects.
3. Based on 1960-70 growth in ASLA membership.
4. Source: ASLA.
5. Source: U.S. Department of Labor, Bureau of Labor Statistics, "Occupational Manpower and Training Needs," Bulletin 1701, 1971.
6. Source: Gary C. Robinette, ASLA, personal communications.
7. Same percentage increase as 1960-70.
8. For 1970 -- includes 1,175 in horticultural services (estimated from survey by Horticultural Research Industitute, Inc.) and 4,000 in natural resource planning (estimate by Mr. Robinette). Proportion of total assumed to be the same in 1960 and 1980.
9. Forty-six percent of those in the private sector are in private practice.

Professional employment in laboratory animal management will more than double during the 1970's.

Figure 60 -- Professionals in Laboratory Animal Management (Excluding Veterinarians), U. S.

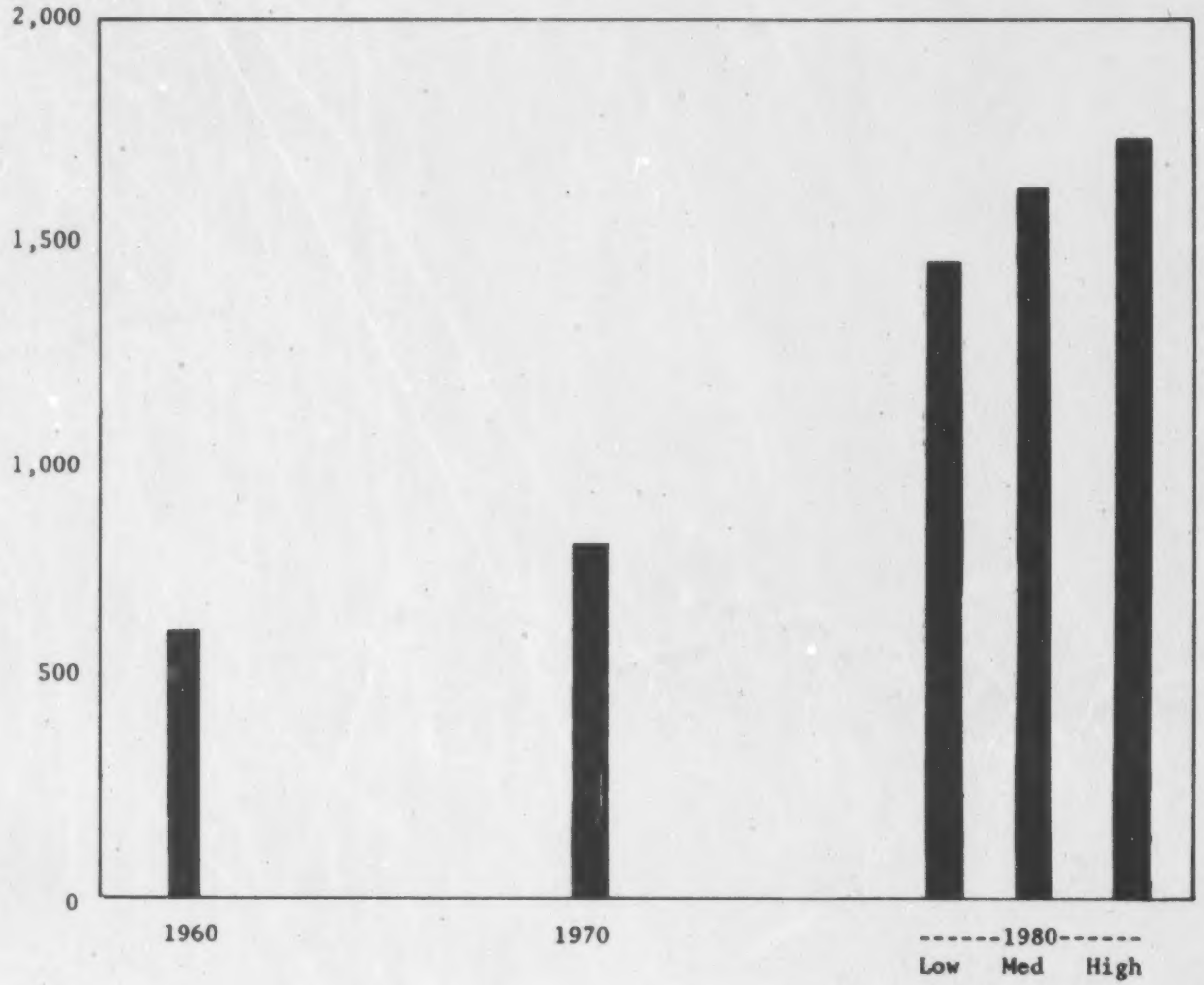

Table 60 -- Professionals in Laboratory Animal Management, U.S.

	1960	1970	1980		
Doctors of Veterinary Medicine	240	340		700	
Other Doctorates	230	325		660	
Other Academically Trained Personnel	330	465		940	
TOTAL	800	1,130		2,300	
Total Excluding DVM's	560	790	1,440	1,600	1,760
Government	190	265		535	
Industry	185	265		535	
Educational Institutions	185	260		530	

Sources: Survey by Institute of Laboratory Animal Resources and "New Horizons for Veterinary Medicine," National Academy of Science - National Research Council and Robert H. Yager, V.M.D., Institute of Laboratory Animal Resources. Assumes growth from 1960 to 1970, and 1970 to 1980 to be same as for DVM's involved with laboratory animals. Low and high for 1980 are 10 percent variances. Breakdown by employer is estimated by authors.

Employment of other professional manpower in agriculture and natural resources in federal, state and local governments will increase 17 percent during the 1970's.

Figure 61 -- Other Professional Manpower in Agriculture and Natural Resources in Government Agencies, U. S.

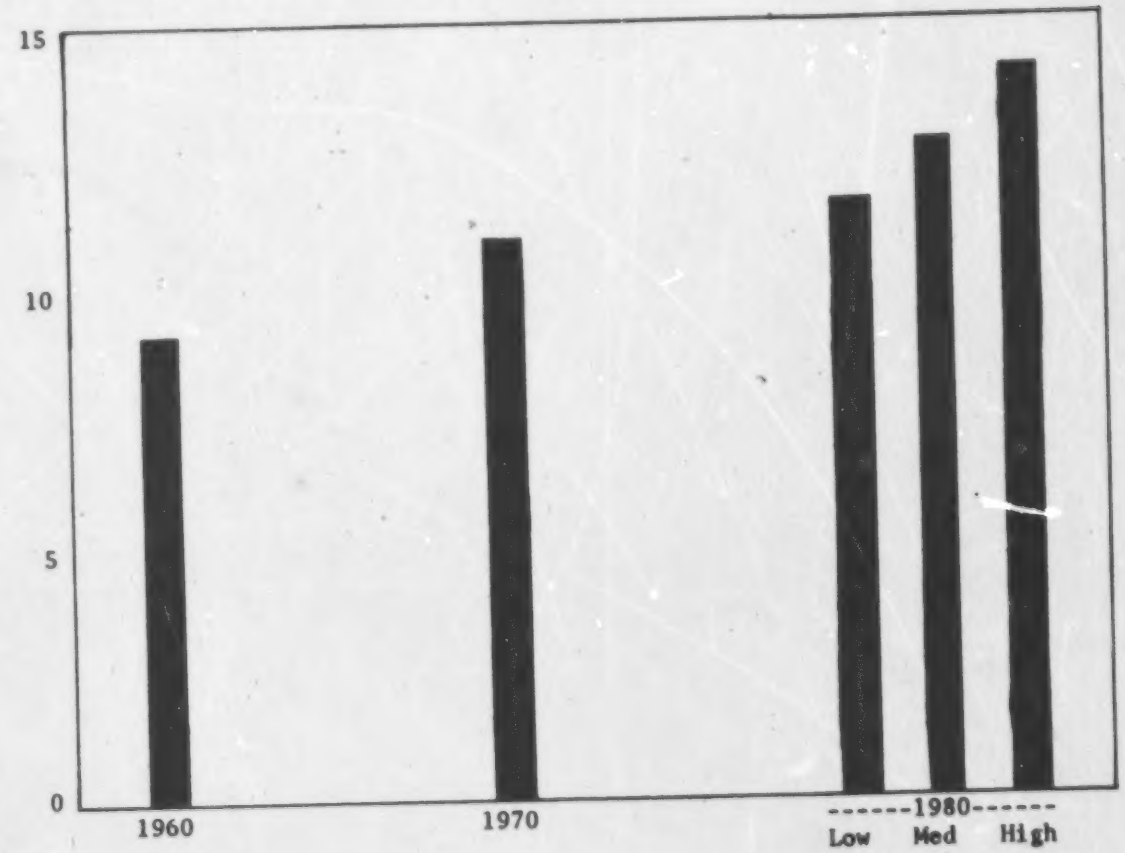

Table 61 -- Other Professional Manpower in Agriculture and Natural Resources in Government Agencies, U.S.

	1960	1970	1980		
Federal					
Agricultural Management	2,845	3,395			
Plant Quarantine and Pest Control	885	955			
Food and Drug Inspection	600	640			
Food and Drug Officers	105	200			
Agricultural Extension[1]	290	160			
Foreign Agricultural Affairs	98	130			
TOTAL	4,815	5,480	5,610[2]	6,235[3]	6,860[2]
State and Local Government[4]	4,220	5,460	5,870[2]	6,520	7,170[2]
Other[4]					
Total Federal, State and Local	9,035	10,940	11,480	12,755	14,030

1. Does not include cooperative extension personnel in the state.
2. Ten percent variance.
3. Same percentage increase as 1960 to 1970.
4. Twice the number of agricultural scientists estimated to be in the state and local governments. Includes regulatory personnel, administrators, etc.

Source: National Science Foundation.

SECTION VI

Enrollment and Degrees, Bachelor's and Advanced Degree Programs
Agriculture and Natural Resources

United States

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To meet the increased demand for professional manpower in agriculture and natural resources in the U. S., it would appear that enrollments and degrees should increase nearly 50 percent from 1970 to 1980.

Figure 62 -- Enrollment and Degrees in Agriculture and Natural Resources, U. S.

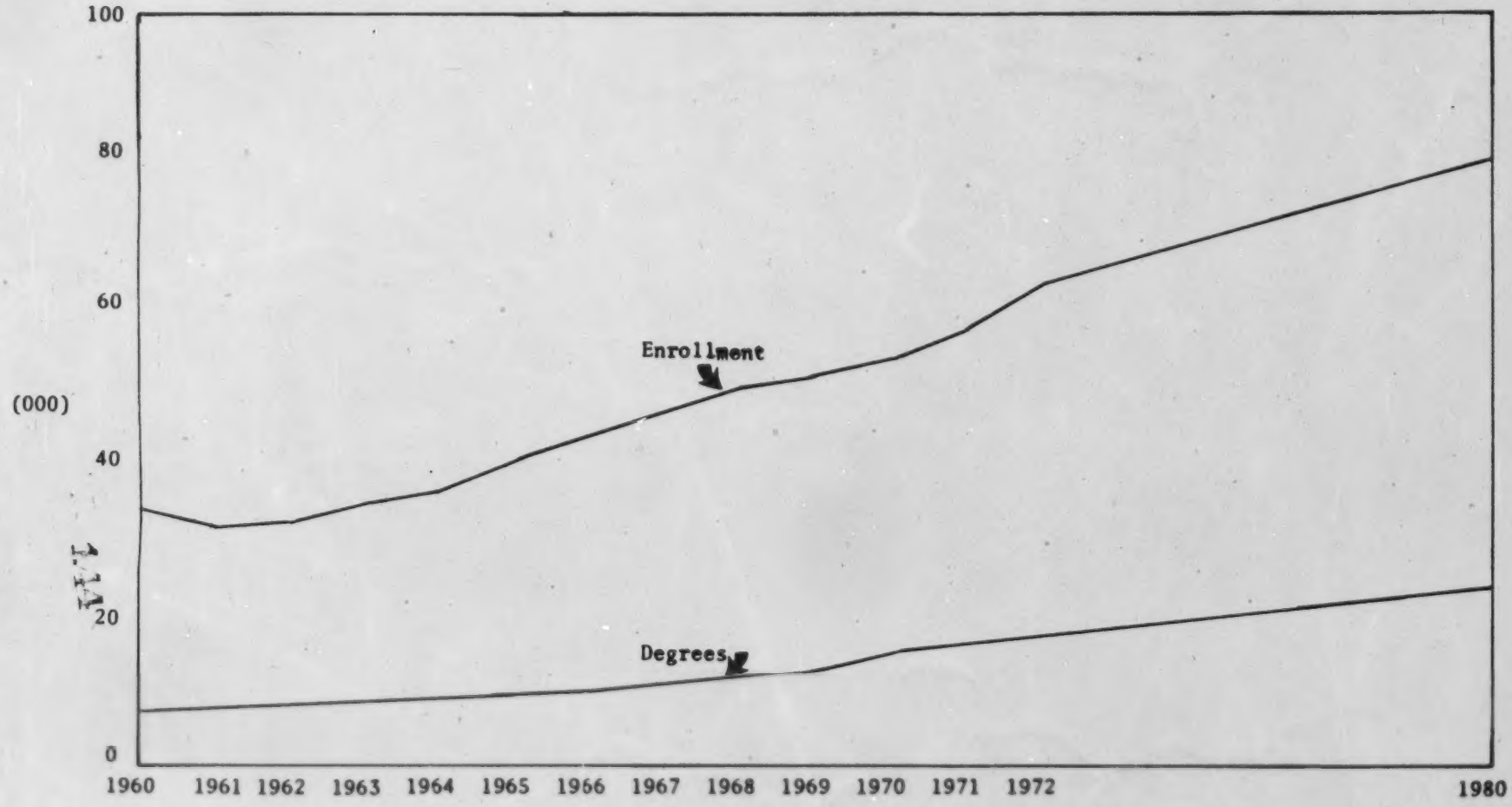

Table 62 -- Enrollment and Degrees in Bachelor's Programs in Agriculture and Natural Resources

(000)

	1960-1	1961-2	1962-3	1963-4	1964-5	1965-6	1966-7	1967-8	1968-9	1969-70	1970-1	1971-2	1972-3	1980-1
Enrollment in Land-Grant Colleges[1]	33.4	32.5	33.0	35.0	37.6	41.8	44.6	47.7	50.3	52.4	54.3	58.7	64.8	80.4[2]
Degrees in Agriculture and Natural Resources[3]	7.4	7.5	7.7	7.9	8.3	8.7	9.6	10.3	12.2	13.9	15.8	NA	NA	23.4[2]

1. Opening fall enrollment in member colleges of the National Association of State Universities and Land-Grant Colleges. (Annual survey by Louis M. Thompson, Associate Dean of Agriculture, Iowa State University.) Land-Grant Colleges have about two-thirds of total higher education enrollment in agriculture and natural resources in the U.S.

2. 48.1 percent increase over 1970-1, same increase as for total professional manpower in agriculture and natural resources.

3. Degrees awarded by all institutions of higher education in the U.S. Source of historic data: U.S. Office of Education, National Center for Educational Statistics.

If the number of bachelor's degrees awarded in agriculture and natural resources parallels the projected growth in total college enrollment in the U. S., there will be a shortage of trained manpower by 1980. Continuation of trends of the 1960's would mean an apparent surplus.

Figure 63 -- Supply of and Demand for Bachelor's graduates in Agriculture and Natural Resources, U. S.

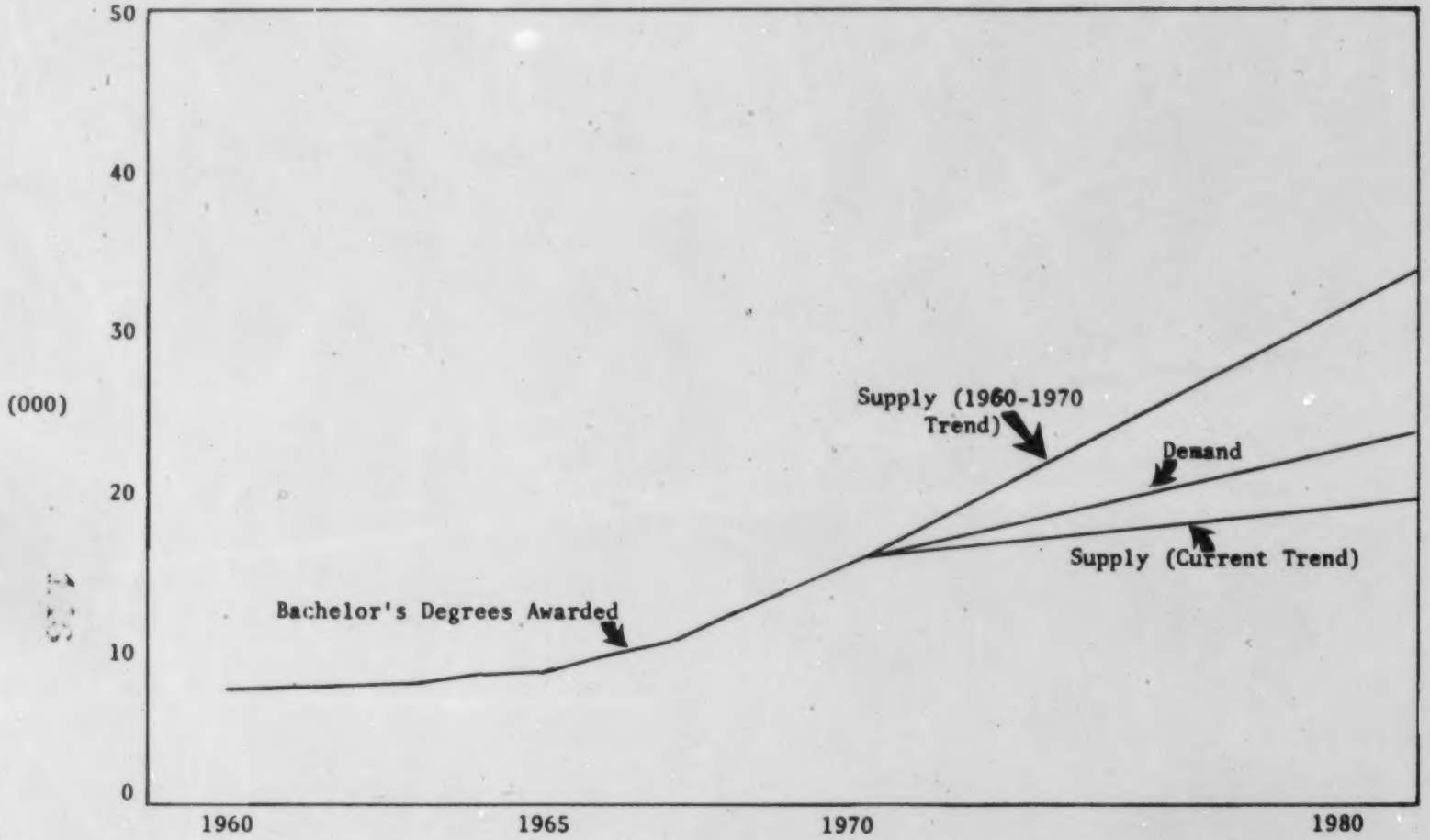

Table 63 -- Supply of and Demand for Bachelor's Graduates in Agriculture and Natural Resources, U.S.

(000)

	1960-1	1961-2	1962-3	1963-4	1964-5	1965-6	1966-7	1967-8	1968-9	1969-70	1970-1	1980	
Bachelor's Degrees (Supply)[1]	7.4	7.5	7.7	7.9	8.3	8.7	9.6	10.3	12.2	13.9	15.8	19.3[2]	33.7[3]
Annual Increase (percent)	-	1.8	1.9	2.3	5.4	5.6	9.8	7.0	19.1	13.5	13.5		
Demand													23.4[4]

1. Degrees in agriculture and natural resources awarded by all institutions of higher education in the U.S. Source of historic data: U.S. Office of Education, National Center for Educational Statistics.

2. Based on medium projection of bachelor's degrees granted, all fields (Table 8).

3. Extrapolation of 1960-70 growth.

4. From Table 62.

Graduates in agriculture and natural resources now occupy less than 40 percent of the total number of professional positions in agriculture and natural resources. The number of graduates from agriculture and natural resources bachelor's programs will need to increase by an amount ranging from 48 to 63 percent by 1980, compared with 1970. This will provide for further occupational upgrading. It will also compensate for a decline in entrants from other fields -- such as the natural sciences and engineering -- whose graduates enter agriculture and natural resource occupations and whose enrollment is leveling or declining.

Figure 64 -- Proportion of Professional Positions Filled by Agriculture & Natural Resource Graduates, U. S.

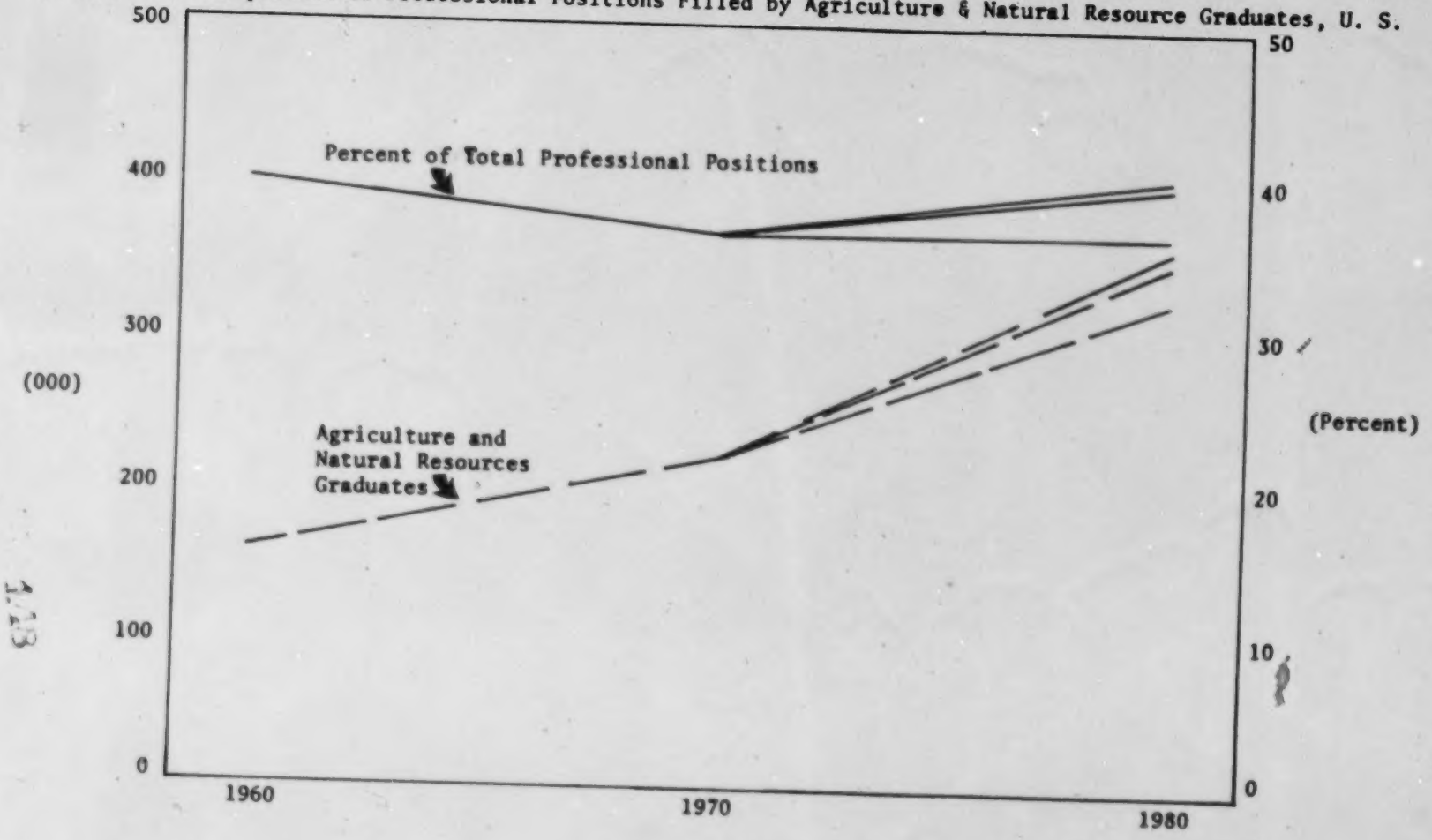

Table 64 -- Proportion of Professional Positions in Agriculture and Natural Resources Filled by Graduates of Agriculture and Natural Resources, U.S.

	1960	1970	1980		
Total Professional Manpower	399,215	595,555		882,000	
Agriculture and Natural Resources Bachelor's Graduates[1]	156,355	216,625	321,050	345,745	352,800
Proportion (percent)	39.2	36.4	36.4[2]	39.2[3]	40.0[4]

1. Eighty percent of all living bachelor's graduates in agriculture and natural resources under age 70, computed by use of life expectancy tables. It is estimated that 80 percent of all graduates are in positions related to agriculture and natural resources (based on studies of agricultural scientists by the National Science Foundation, engineers by the Engineers Joint Council, and foresters by the authors).

2. Same as 1970.

3. Same as 1960.

4. Goal.

Total number of bachelor's degrees awarded in agriculture and natural resources during the 1970's could more than double over the number awarded during the 1960's and not result in unemployment.

Figure 65 -- Bachelor's Degrees Granted in Agriculture and Natural Resources, by Decade, U. S.

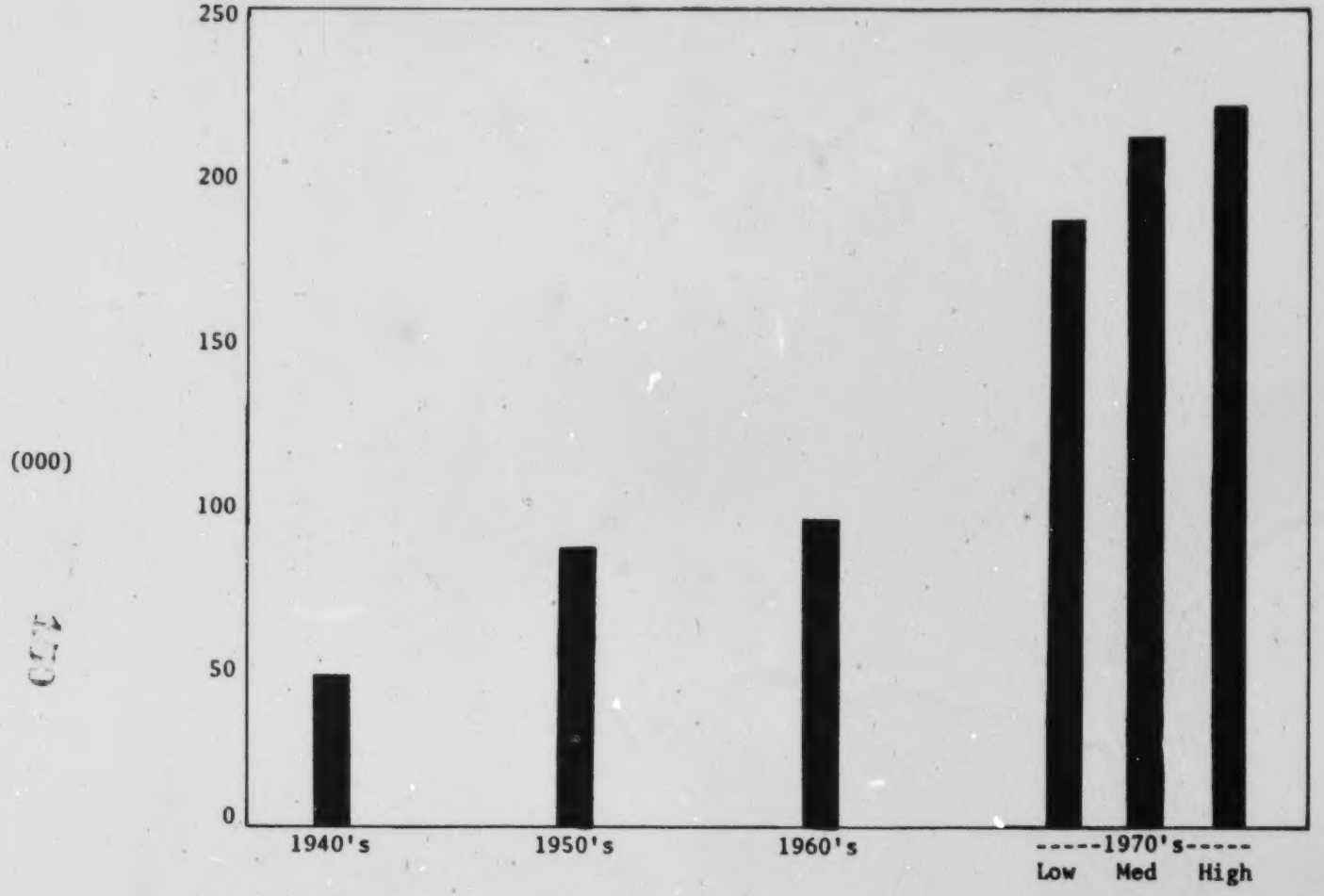

Table 65 -- Bachelor's Degrees Granted in Agriculture and Natural Resources, by Decade, U.S.

	1940's	1950's	1960's	1970's[1] Low	1970's[1] Medium	1970's[1] High
Number	46,660	84,575	93,535	180,500	211,720	220,650
Percent Increase	-	81.3	10.6	93.0	126.4	135.9

1. Number of graduates in agriculture and natural resources required during the decade to reach the total number of living graduates of agriculture and natural resources needed by 1980 (see Table 64).

The number of bachelor's degrees awarded in agriculture and natural resources must increase by at least 50 percent from 1970 to 1980. Eighty percent more graduates in 1980 as in 1970 could probably be absorbed into the job market.

Figure 66 -- Need for Bachelor's Degrees in Agriculture and Natural Resources, U. S.

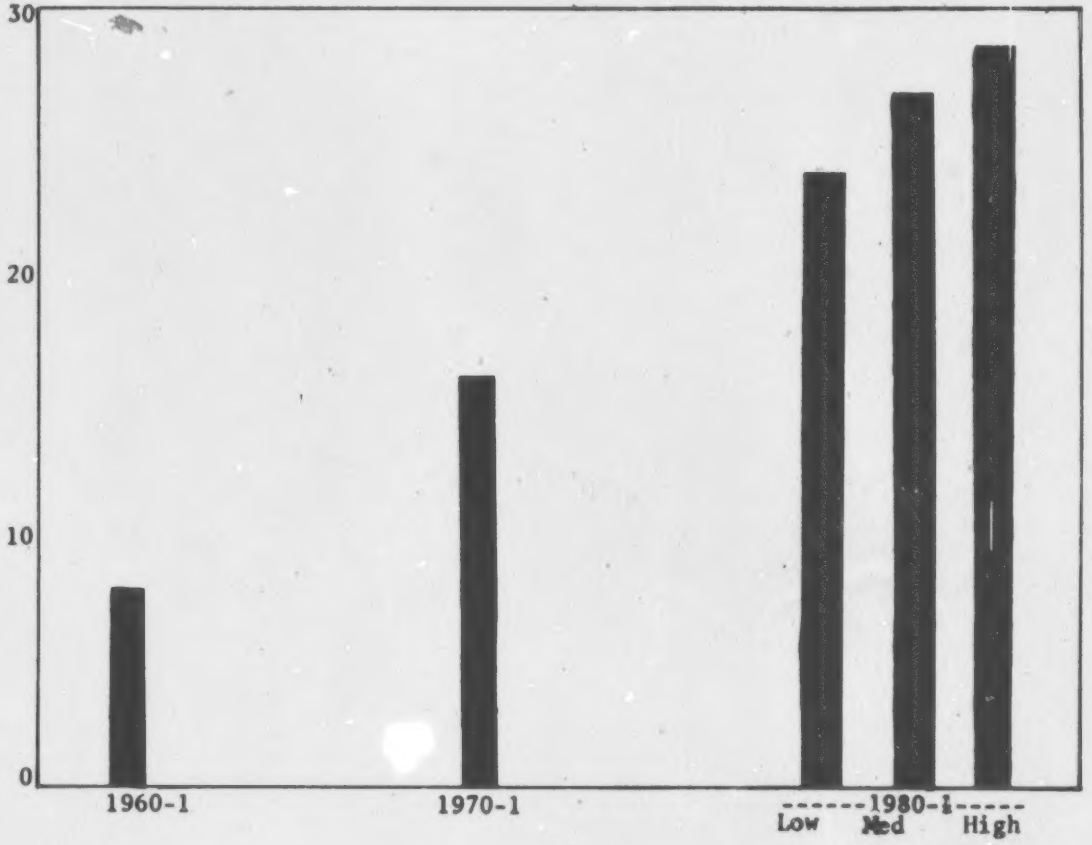

Table 66 -- Need for Bachelor's Graduates in Agriculture and Natural Resources, U.S.

(000)

	1960-1	1970-1	1980-1 Low	1980-1 Medium	1980-1 High
Bachelor's Degrees in Agriculture and Natural Resources	7.4	15.8	23.4[1]	26.6[2]	28.4[2]
Percent Increase	-	113.5%	48.1%	68.4%	79.7%

1. Based on projected increase in professional manpower in agriculture and natural resources.

2. Based on percentage of professional positions in agriculture and natural resources held by graduates in agriculture and natural resources (39.2 and 40.0, respectively). See Table 64.

Supply of forestry graduates available for forestry employment will be in approximate balance with demand for foresters in 1980 if the number of degrees awarded increases at the same rate as in the 1969-71 period. However, continuation of the very rapid increases in freshmen enrollment of the past several years could result in a modest surplus of forestry graduates.

Figure 67 -- Supply of and Demand for Bachelor's Graduates in Forestry, U. S.

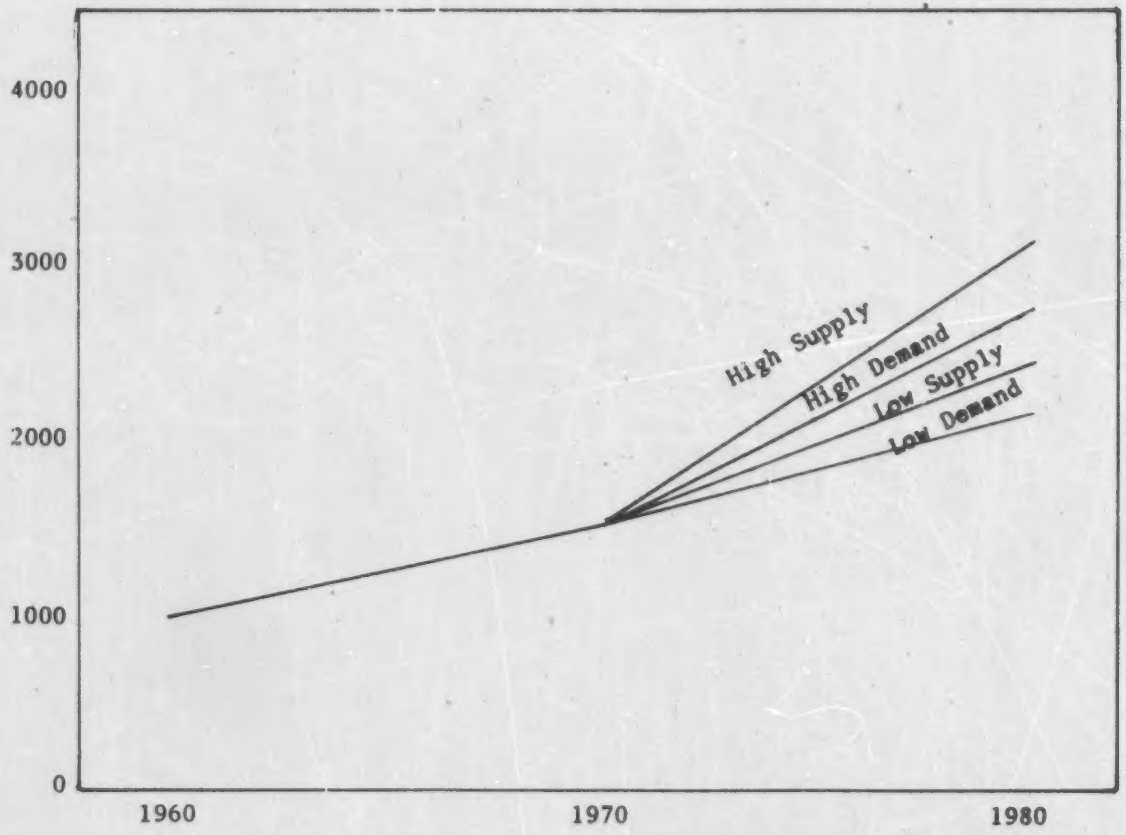

Table 67 -- Supply of and Demand for Bachelor's Graduates in Forestry, U.S.

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1980 Low	1980 High
Enrollment[1]	8704	8439	8757	8804	9412	10339	11118	12358	13312	13480	19313	NA		
Degrees[1]	1473	1577	1595	1626	1593	1694	1835	1890	1879	2427	2703	2830	4950[2]	6555[3]
Available for Forestry Employment[4]	945										1535		2445	3240
Demand for Foresters													2275[5]	2780[6]

1. Source of 1960-71 data: Marckworth, Gordon D., "Statistics From School of Forestry for 1971," Society of American Foresters.

2. 6.4 percent annual increase (average of 1969-71 growth) from 1972 to 1980.

3. Based on trends in freshman enrollment through fall, 1972 (source: Society of American Foresters), then 6.4 percent annual increase in degrees awarded from 1977 to 1980. Freshman enrollment trends:

1967 - 3676	1970 - 5525
1968 - 3721	1971 - 6355 (estimated by SAF)
1969 - 5068	1972 - 7310 (estimated by SAF)

4. Calculated as follows:

	1960	1970	1980
A. Percent of forestry school graduates with majors in forestry (excludes those majoring in wildlife management and range management, and one-half of those majoring in forest recreation and other specialties).	80.0	70.9	61.8
B. Percent accepting positions in forestry.	80.0	80.0	80.0
C. Available for forestry employment (A x B)	64.0	56.7	49.4

Note: This calculation was checked by computing the anticipated number of living forestry graduates under age 70 in 1960 and 1970, using data on degrees granted, and life expectancy tables; then, the numbers were reduced by applying the above percentages. The result was very close to the number of foresters estimated by the Society of American Foresters.

5. Same percentage increase over 1970 as for total professional forestry employment (Table 54, medium projection).

6. Calculated as follows:

Annual growth, 1980	1330
Replacement @ 4%	1450
	2780

Demand for doctorate graduates in agriculture and natural resources will increase by at least 36 percent and possibly by as much as 78 percent by 1980. Demand for master's degree graduates will grow 44 to 59 percent.

Figure 68 -- Graduate Enrollment and Degrees in Agriculture and Natural Resources, U. S.

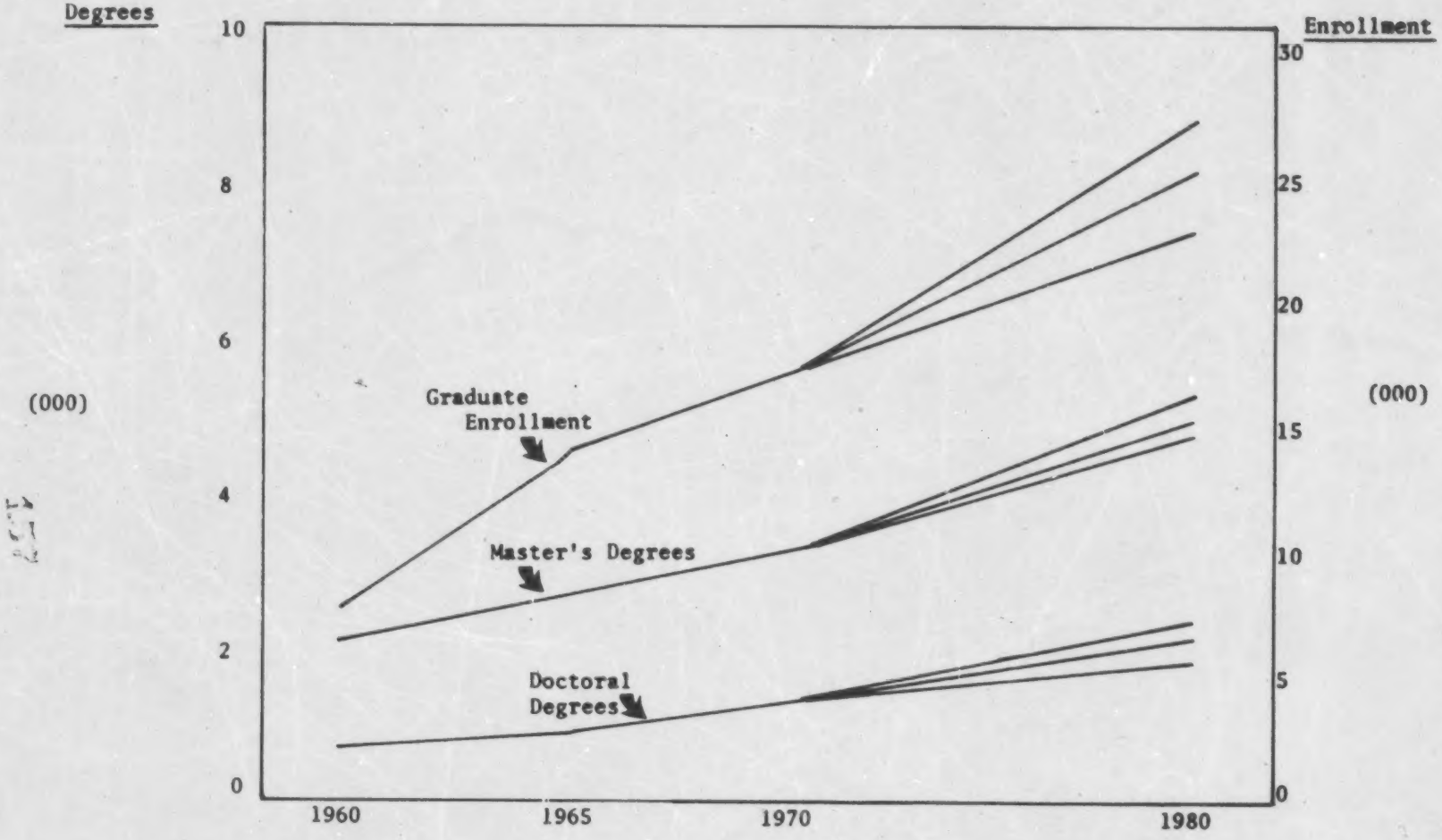

Table 68 -- Graduate Enrollment and Degrees in Agriculture and Natural Resources, U.S.

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1980 Low	1980 Medium	1980 High
Graduate																
Enrollment[1]	8813	9030	10195	11570	13480	14582	14675	16213	15734	16060	16691	16227	18180	23700		27425
Increase over 1970 (%)														42.0	52.2	64.3
Master's[2]																
Degrees	2094	2339	2109	2217	2287	2765	2912	3054	NA	NA	3326	NA	NA	4790	4925	5280
Increase over 1970 (%)														44.0[3]	48.1[4]	58.8[5]
Doctorate[6]																
Degrees	712	741	726	840	898	953	1038	1072	NA	NA	1341	NA	NA	1830	2150	2385
Increase over 1970 (%)														36.4[7]	60.3[8]	77.8[9]

1. Opening fall enrollment in Land-Grant colleges. Source: Thompson, L. M., Iowa State University, annual survey. Projections are based on a composite of the projections for master's and doctor's degrees.
2. Land-Grant and other colleges. Source: U.S. Office of Education, National Center for Educational Statistics. Academic year starting in the year indicated.
3. Projected increase in demand by industry for master's graduates. Source: Survey by E. E. Darrow, College of Agriculture and Home Economics, The Ohio State University, survey, spring, 1971.
4. Based on projected total increase in professional manpower in agriculture and natural resources (Table 41).
5. Same percentage increase as 1960-70.

6. Land-Grant and other colleges. Source: U.S. Office of Education, National Center for Educational Statistics. Academic year starting in the year indicated.

7. Same increase as for agricultural scientists.

8. Based on low projection of increase in the need for Ph.D. scientists and engineers (Table 24).

9. Based on high projection of increase in the need for Ph.D. scientists and engineers (Table 24).

NA = not available.

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SECTION VII

Selected Professional Manpower Trends
and Enrollment and Degrees, Bachelor's and Advanced Degree Programs
Agriculture and Natural Resources

Ohio

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Number of teachers in vocational agriculture in Ohio will increase faster than for the U. S. as a whole.

Figure 69 -- Vocational Agriculture Teachers, U. S. and Ohio

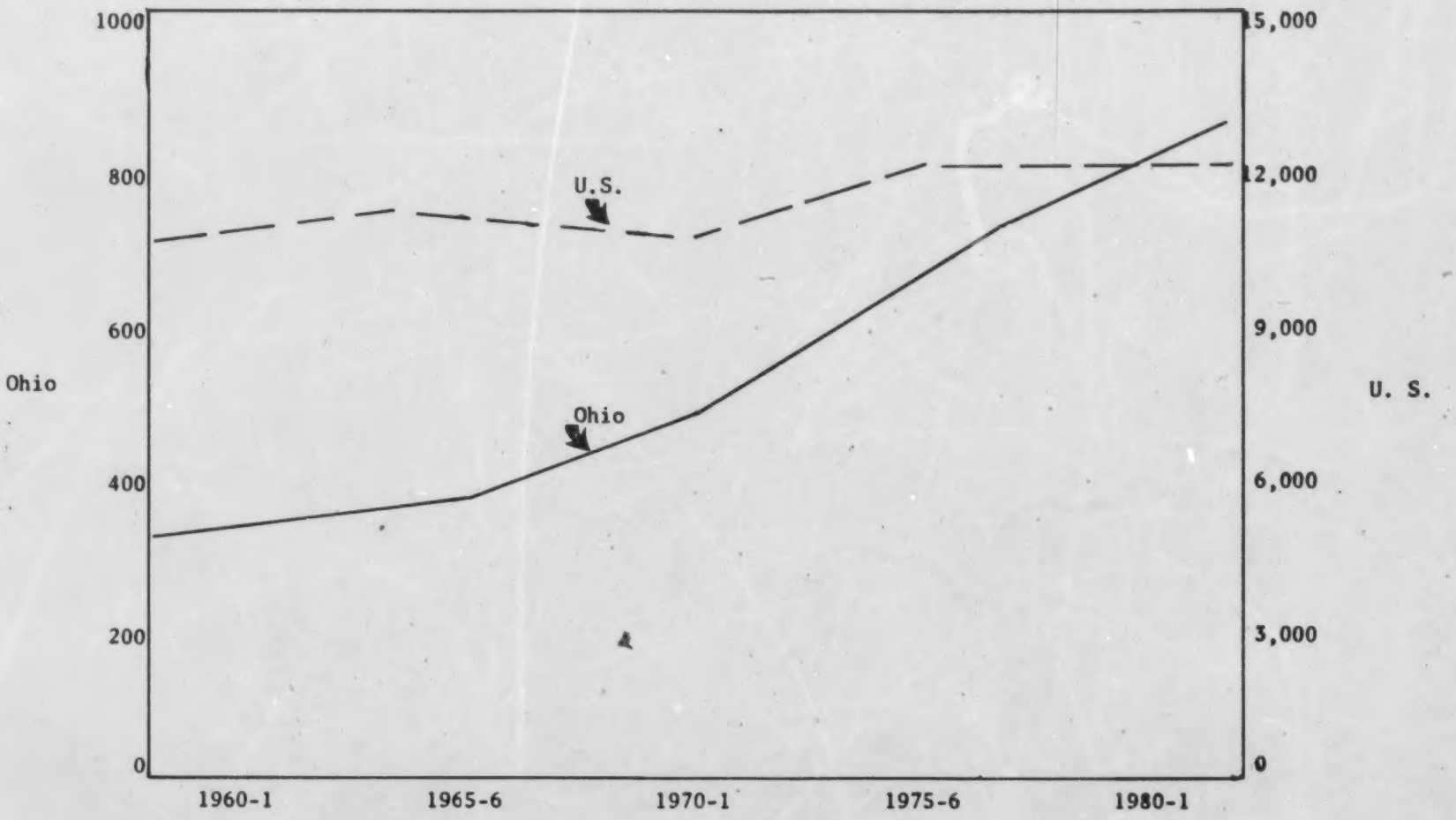

Table 69 -- Vocational Agriculture Teachers, Ohio

	1960-1	1965-6	1970-1	1971-2	1972-3	1975-6	1980-1
Enrollment (000)							
High School	11.3	13.3	17.1	19.5	21.3	25.2	30.7
Adult	10.4	10.8	12.1	12.0	12.0	14.0	16.0
TOTAL	21.7	24.1	29.2	31.5	33.3	39.2	46.7
Faculty							
High School	332	374	475	495	526	657	767
Adult					13		60
Supervisors					15		60
Students per Teacher (high school)	34.0	35.6	36.0	39.4	40.4	38.4	40.0
Annual New Employment							
New Positions		8	20	20	31	42	22
Replacements at 10 percent		37	48	50	53	66	77
TOTAL		45	68	70	84	108	99

Source: John P. Morgan, Agricultural Education Service, Ohio Department of Education.

Demand for faculty for two-year technical programs in agriculture and natural resources in Ohio will increase faster than for the U. S. as a whole.

Figure 70 -- Two-year Technical Faculty in Agriculture and Natural Resources, U. S. and Ohio

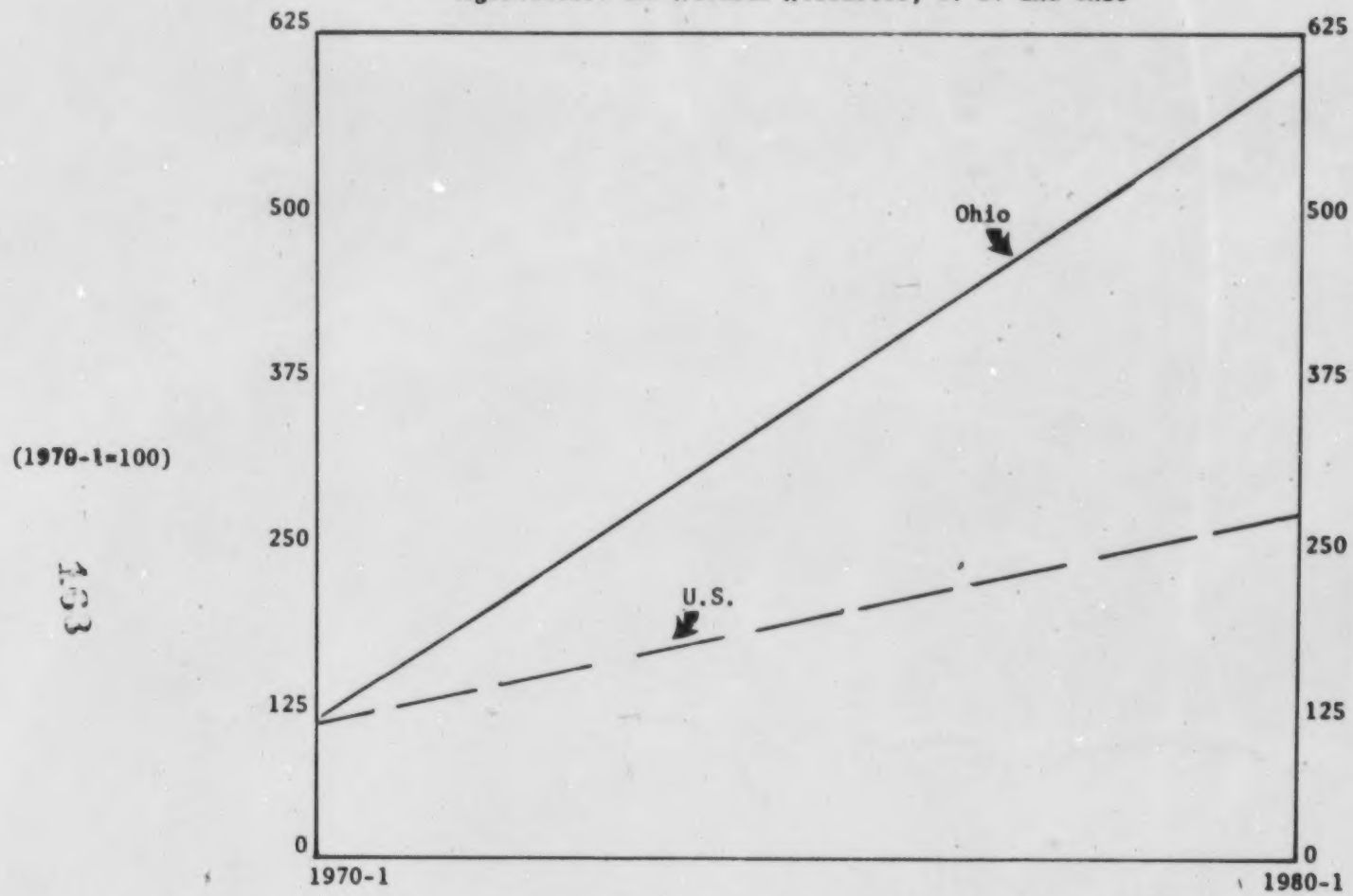

Table 70 -- Two-Year Technical Faculty in Agriculture and Natural Resources, Ohio

	1965-6	1970-1	1971-2	1972-3	1975-6	1980-1[1]	1985
Enrollment							
Agricultural Technical Institute - OSU[2]	--	--	--	189	575	1000	1000
Other	90	314	643	737	875	1450	2200
TOTAL	90	314	643	926	1450	2450	3200[3]
Teachers	10	27	33	65	96	162	210
Students per Teacher	9.0	11.6	19.5	14.8	15.1	15.0	15.0
Annual New Employment							
New positions	--	3	6	32	10	13	10
Replacements at 10 percent	--	1	1	2	5	8	11
TOTAL	--	4	7	34	15	21	21

1. Projections based on previous trends.
2. Source: Halterman, J. J., private communications.
3. Source: Resident Instruction Task Force Report, "Life 2000," College of Agriculture and Home Economics, The Ohio State University.

Source of other data: Ohio Department of Education.

Managers, salesmen and related occupations in agribusiness represent the largest category of agriculture and natural resources professional manpower in Ohio.

Figure 71 -- Professional Manpower in Selected Occupations in Agriculture and Natural Resources, Ohio, 1970

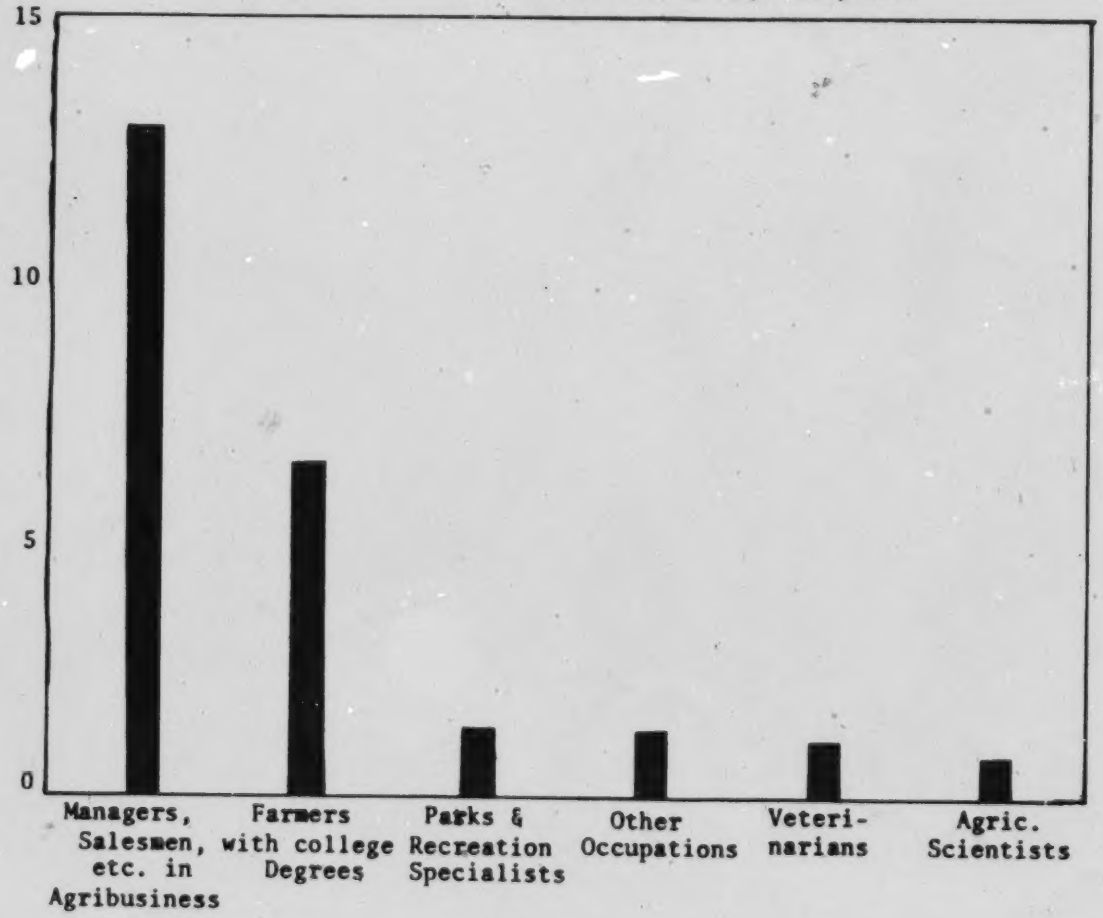

Table 71 -- Professional Manpower in Agriculture and Natural Resources, by Occupation, Ohio, 1970

Managers, Salesmen and Related Business and Industry Occupations	
Sales Managers and Salesmen	6,337
Managers and Administrators	4,401
Purchasing Agents and Buyers	1,837
Others[1]	296
SUBTOTAL	(12,871)
Agricultural Scientists[2]	810
Agricultural Engineers[3]	287
Vocational Agriculture Teachers	475
Two-Year Technical Agriculture and Natural Resources Teachers	27
Farmers with College Degrees	6,479
Farm Management Advisors[4]	107
Veterinarians	1,007
Foresters and Conservationists[5]	687
Parks and Outdoor Recreation Specialists[6]	1,380
Other Government Employees[7]	385
Pollution Control Specialists[6]	400
Landscape Architects	120
Other[8]	1,250
TOTAL	26,285

1. Includes office managers, personnel managers, public relations personnel and others from selected industries.

2. Includes faculty in research, extension and resident instruction; biologists and chemists in agricultural industries; and agricultural scientists in government and industry.

3. All engineers in agricultural industries.

4. Excludes cooperative extension agents, who are included under "agricultural scientists."

5. Includes fisheries and wildlife, as well as forestry personnel.

6. Five percent of U.S. total (based on population).

7. Ohio Department of Agriculture.

8. Five percent of all other categories.

Sources: U.S. Bureau of the Census, 1970 census; Ohio Department of Education.

Note: Only partial data are included for some categories, and categories are not strictly comparable to those for the U.S. in preceding tables. Total figure may be understated.

In view of national and statewide manpower trends, enrollment and degrees in bachelor's programs in agriculture and natural resources of The Ohio State University should nearly double by 1980, compared with 1970.

Figure 72 -- Bachelor's Enrollment and Degrees in Agriculture and Natural Resources, The Ohio State University

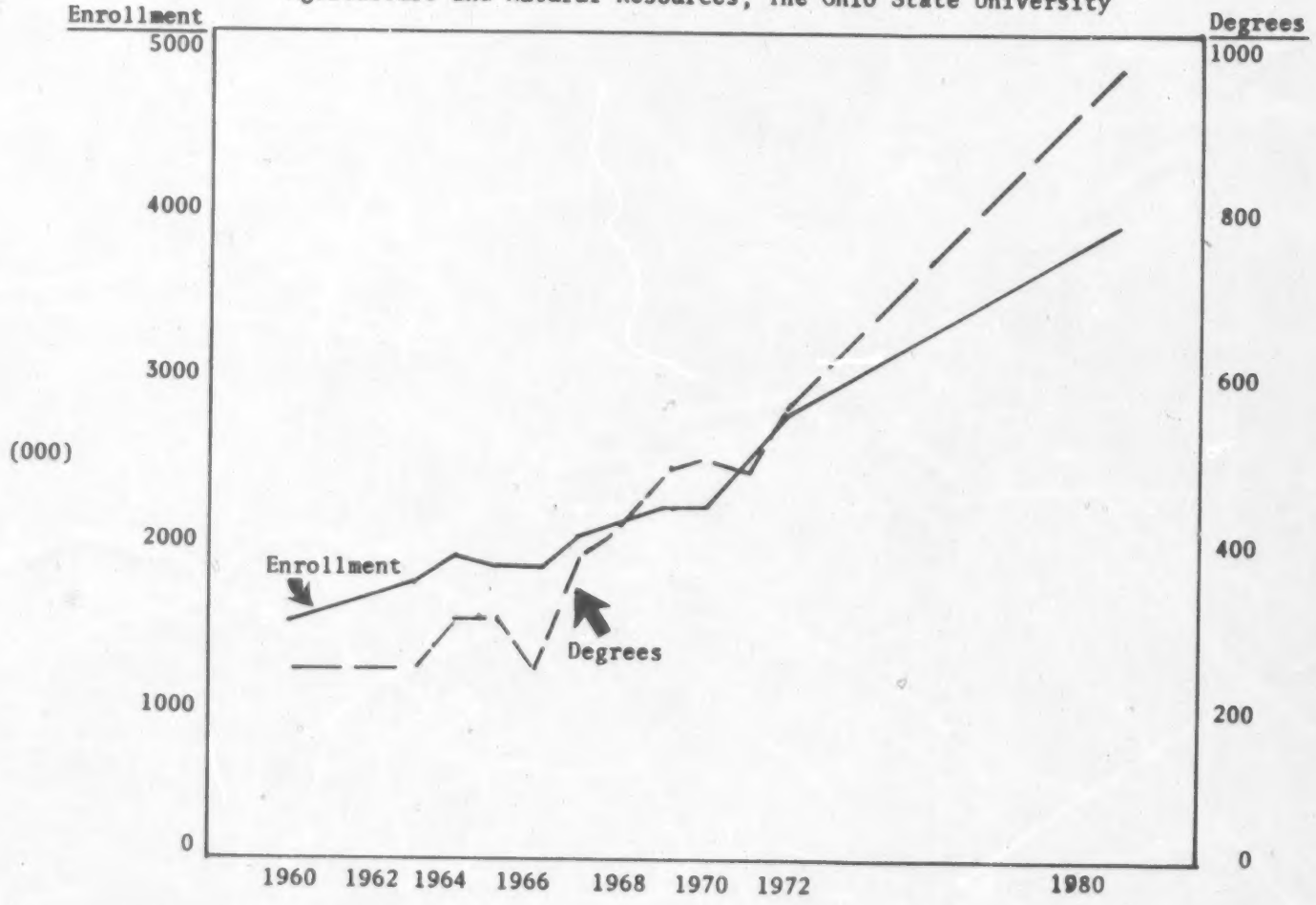

Table 72 -- Bachelor's Enrollment and Degrees in Agriculture and Natural Resources, The Ohio State University

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1980[3] Low	1980[3] Medium	1980[3] High
Enrollment[1]	1416	1498	1553	1640	1803	1752	1765	1934	2043	2133	2142	2450	2752	3470	3875	4135
Degrees[2]	231	212	216	230	290	289	237	365	414	470	487	471	540	790	880	940
Increase over 1970														62.0%	81.0%	93.0%

1. Opening fall enrollment for the year indicated. Includes agriculture-and natural resources-decided students enrolled in University College starting with 1969.

2. Granted during the academic year starting in the year indicated. Includes agricultural engineering.

3. Increased above national projections (low and medium projections, Table 66) on the basis of Ohio's needs for vocational and technical agriculture teachers, and employment needs of the state's departments of agriculture and natural resources (information on the latter was obtained through personal communications with representatives of the two agencies). High projection is same as in Table 66.

The number of graduate degrees in agriculture and natural resources at The Ohio State University should increase by the same proportion as for the U. S. as a whole.

Figure 73 -- Graduate Degrees in Agriculture and Natural Resources, The Ohio State University

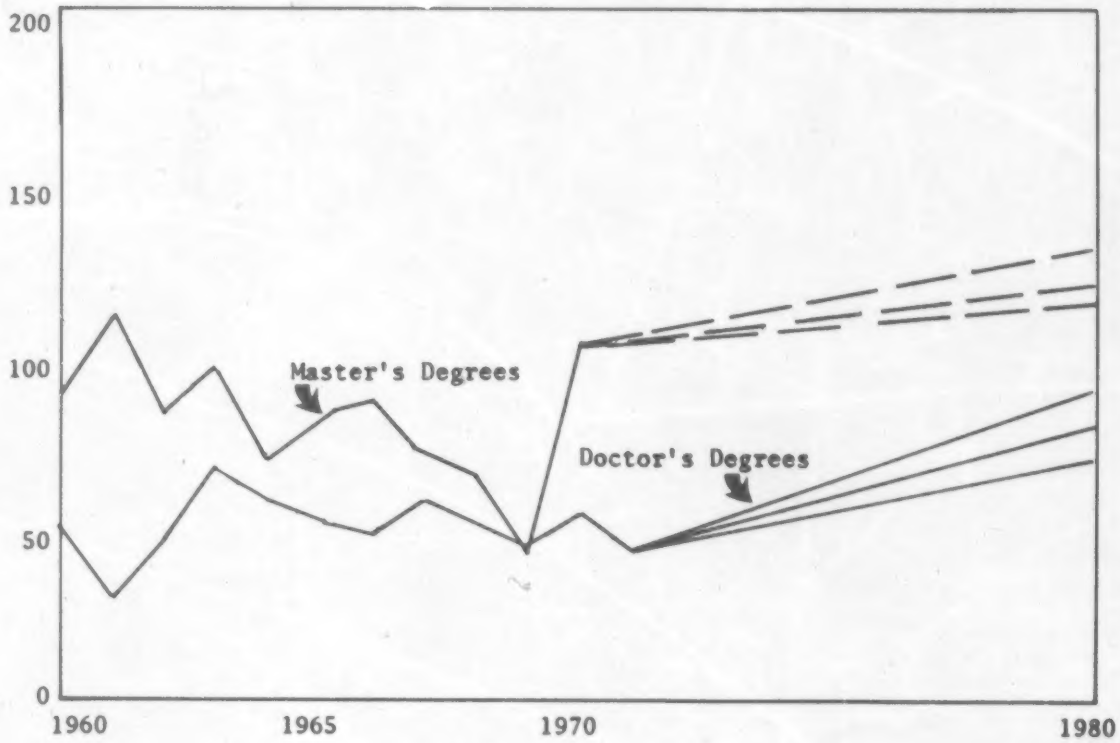

Table 73 -- Graduate Degrees in Agriculture and Natural Resources, The Ohio State University

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1980[2] Low	1980[2] Medium	1980[2] High
Master's[1]	88	112	84	96	72	80	85	70	NA	41	65	103	115	120	130
Doctorate[1] Degrees	50	30	47	67	59	52	48	58	NA	44	54	44	70	80	90

1. For the academic year starting in the year indicated.

2. Same percentage increases as for U.S. (see Table 68), using the 1960-71 average as the basis for projection.